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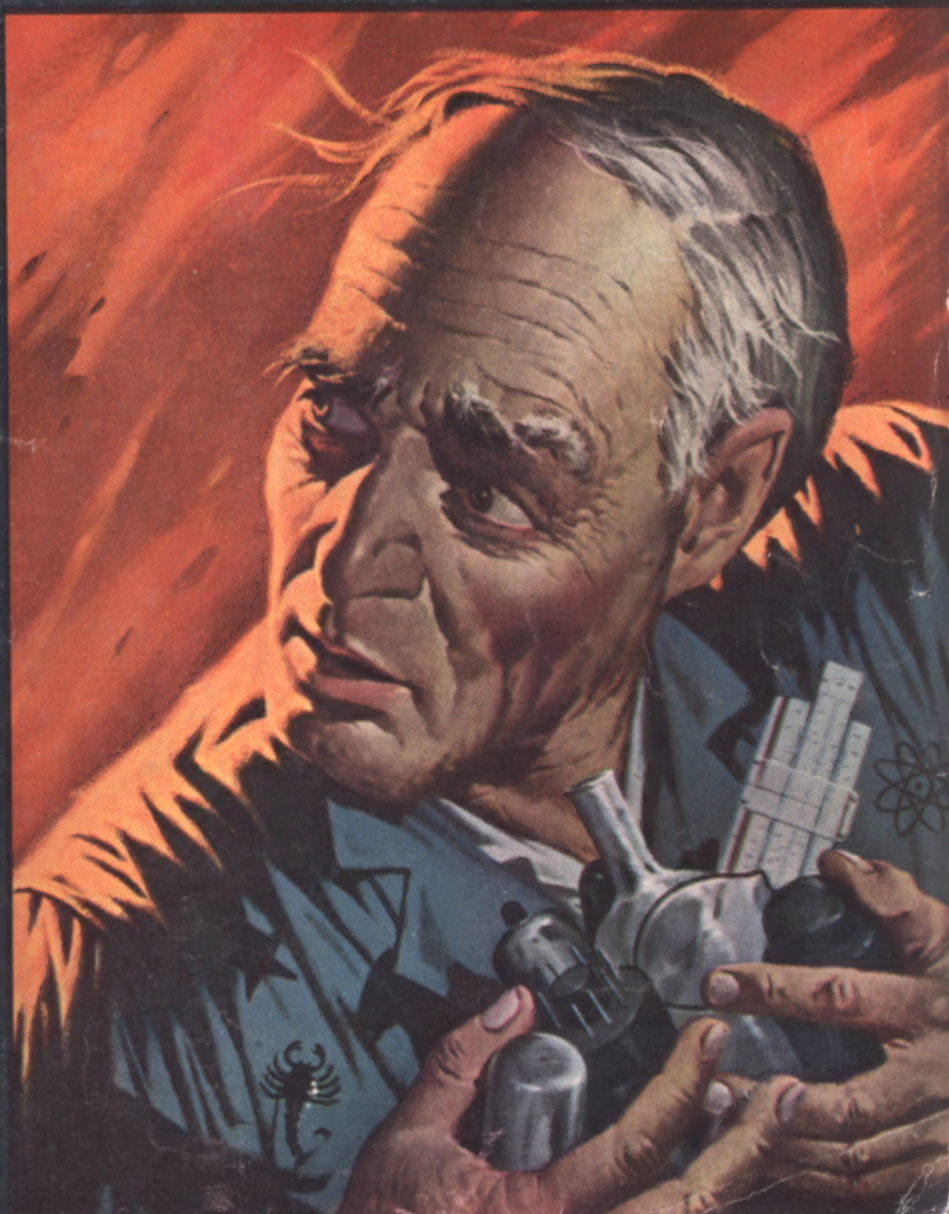

Hide! Hide! Witch! BY MARK CLIFTON AND ALEX APOSTOLIDES

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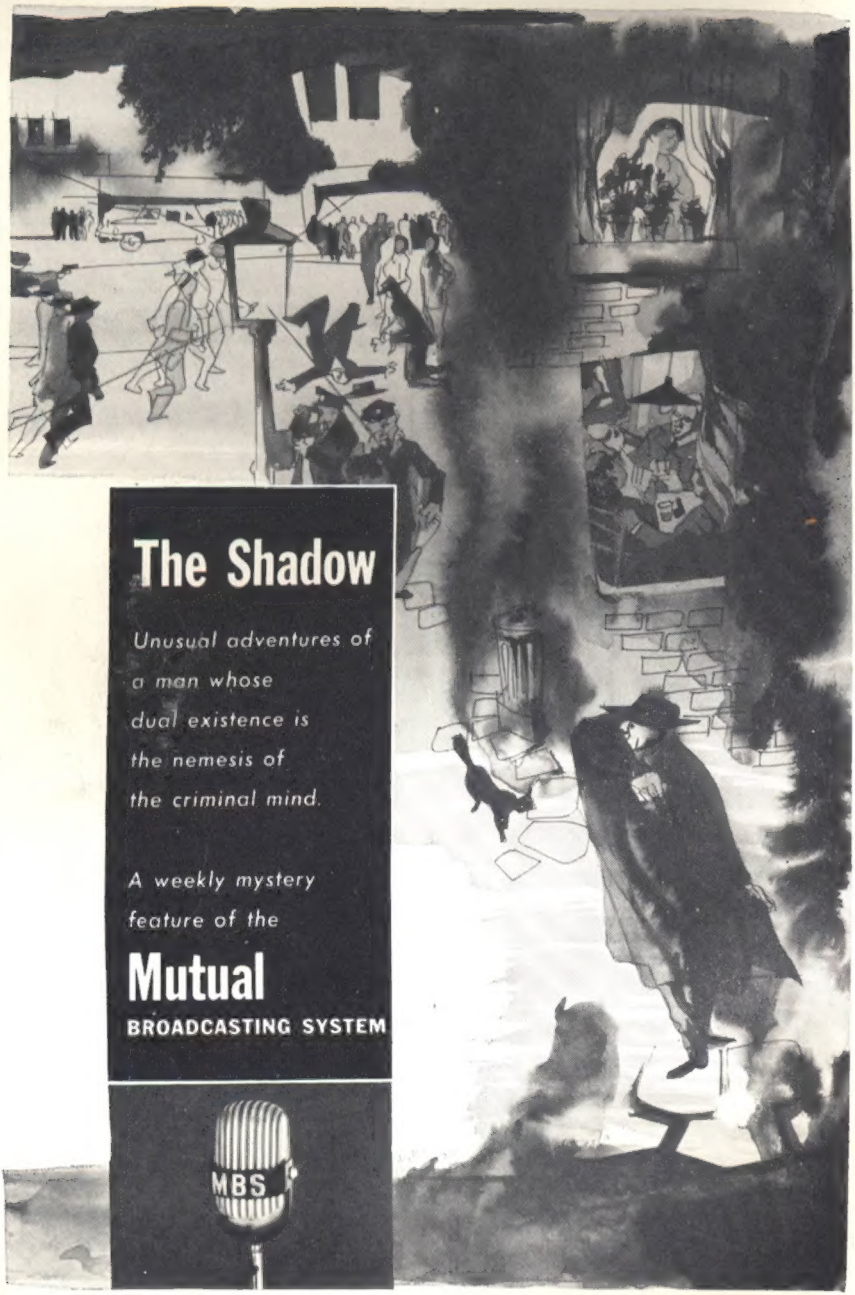
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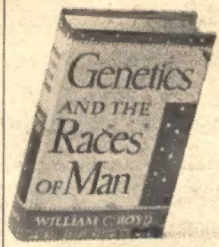

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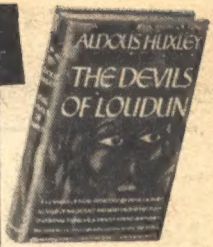

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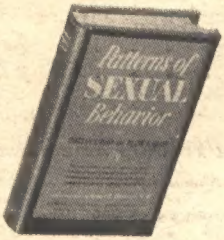

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EDITORIAL

THE SCIENTIST

The philosophy of the true scientist is one of the few things he does not, ordinarily, express clearly; this is, in part, because he, of all men, considers human opinions of little import in the scheme of things, and a philosophy appears to be simply a system of human opinions. He's wrong in that to some degree; a philosophy is a theory of the relationships of the Universe, actually—and it is important to state theories clearly, communicate them, and cross-check them with the observations of others.

But because his personal philosophy is so personal, he seldom defines it clearly for others to investigate and consider. Perhaps it would be worth while seeking to find a definition—a clear statement—of the scientist's philosophy. Many of the fine scientists I know and have known appear to me to act on a system of beliefs somewhat like this:

They believe in the existence of a Supreme Authority in the Universe, an Authority they call "Natural Law." They hold that that Authority is above and beyond the opinions and beliefs, the will or willfullness, of any human being. That that Authority can, moreover, be directly consulted by any man, at any time—and that every man is, at every time and in every place, directly and specifically obedient to that Authority, to Natural Law, whether he recognizes that fact or not.

They believe that the highest task of Man is to seek to understand more fully the nature of the Laws of the Universe.

That the highest good of Man is achieved by understanding and working with those Laws, and not by seeking to defy them.

That the *system* of laws is absolutely inescapable, but that any *individual* law can be offset by proper use of others of the total system of laws. That Natural Law is like an equation having many terms; the total equation

must always be in balance, but that any one factor on one side may be altered at will by accepting appropriate alteration of factors on the other side of the equation.

That Man thus has free choice with respect to any situation—but he cannot rationally speak of having free choice as to whether he will or will not obey the total system of the Laws of the Universe.

The scientist believes that *he* has made a mistake any time his actions lead to results he did not predict—and that it is sublimely futile to say that the Universe is wrong, or unjust, or irrational.

Since only total knowledge of everything in the total Universe could make possible accurate prediction of all the results of any action, the scientist is necessarily an humble man; he knows he must make mistakes.

But the scientist is also a proud man; he is proud of his willingness to learn, to give up his dearest conviction in the face of a new learning.

The scientist seeks to state his beliefs in the clearest, most unequivocal form he can achieve; thus he can more quickly detect and correct errors in his ideas as to what he thinks the Laws are, and what those Laws actually are.

The scientist seeks to communicate his ideas to other men of high ability and knowledge equal to his own; if he cannot communicate his idea to them, he knows he has not adequately clarified his statements, or has made some error in his development of his idea. He has made a mistake; it is futile to hold the other man at fault. This he learns early, for it is a simple extension of the concept of the futility of blaming the Universe when his experiment goes in a direction other than he predicted. Other people are, clearly, part of any individual scientist's external Universe.

The scientist likes to work with machines. A machine is a structure which has no beliefs, no biases, no willingness to be friendly nor any desire to be inimical, for it has *no* desires. It's utterly honest, granting no favors and refusing no earned reward. A man can fool himself; he can even fool his friends and, sometimes, his enemies. A machine is honest to a fault.

A machine invariably does precisely what you have "told" it to do; if your instructions—i.e., your design—are not clear, the machine does not function as predicted. If it doesn't, the fault is yours—you gave the instructions. Designing and building any type of machine is a powerful lesson in humility and, equally, in self-respect. If it works, you know precisely why it does; if it doesn't, you may not know why, but you must, inescapably, acknowledge an error, for the machine will not function until you do acknowledge that you have made an error, and both seek and find that error.

Continued on page 161

Illustrated by Kirberger

HIDE! HIDE! WITCH!

He knew *he wasn't a witch—but he neglected one important factor in his computations. It's the citizens around who act against the witch, and they act on what they believe!*

BY MARK CLIFTON AND ALEX APOSTOLIDES

Hide! Hide! Witch!
The good folk come to burn thee!
Their keen enjoyment hid beneath
The gothic mask of duty.

Jonathan Billings, Dean of Psychosomatic Research at Hoxworth University, heard the knock on his study door, and looked up from his work at his desk. But before he could call out an invitation to enter, the door opened.

That would be Mr. Rogan, Resident Investigator. Anyone else would have waited.

Billings watched him without expression as he came through the door —a little man, a negative quantity, who wore heavy silver-rimmed glasses in the hope they would give character to a characterless face. The brief case he carried, too, was heavily decorated with silver, proclaiming its unusual importance. He needed these trappings, and more. He was the kind of man one forgot to introduce, and his whole bearing suggested his determination to command the attention he never quite received.

There was a portentous frown on his gray face, and without any preliminaries of greeting he bustled over and laid a new issue of the college paper on Billings' desk. Billings looked down at the open page, and a cartoon of himself looked slyly back.

That was the trouble of having an old, old face with a thousand wrinkles. Even seventy years had been unkind in putting so many wrinkles there. In a cartoon, and he was often the subject of them throughout the country, those wrinkles could be slanted to make him appear fine and noble, or sly and scheming. It would depend upon which faction of the public the cartoonist wanted to please.

This time, in the cartoon, he was sly; and had his finger held up toward his lips in a cautioning, secretive gesture. There was a caption in bold print beneath the cartoon.

"You were quite wrong, Albert, about the nature of the universe!"

Billings looked up from the cartoon with a slight smile and met the accusing expression in Rogan's washed blue eyes.

"This is highly irregular, doctor," Rogan said firmly, before Billings could comment. "I trust you have not been questioning indisputable facts! I trust you have not been planting disturbing doubts in the minds of our future citizens! I trust you know Congress approved those facts for school textbooks long ago! It would be most subversive, not to mention a waste of

time and tax money, to question them now!"

Billings felt a flare of sudden irritation, an emotion he considered quite unworthy of the circumstances. He should be accustomed to this sort of thing by now. For the past thirty years there had been a Resident Investigator, some worse and some not any worse than Rogan; monitoring what the teachers said, the lines of thought they pursued. He remembered a long succession of them who had come through his door; some of them resentful that he was world famous and must be handled with especial care; others seeing in it a golden opportunity for personal publicity if they could catch him in some subversive remark.

Out of the montage of accusations and sly traps written in their collective expressions, one face stood out clearly from all the rest. What was the remark the man had made? Oh, yes, he remembered it now.

"I am completely impartial, Dr. Billings," the man had said. "I merely see to it that you teachers say nothing which might threaten our freedom of speech!"

The memory of that incredible twist of semantics, so characteristic of the early days, cleared the irritation from his mind, and he looked back into Rogan's face with equal firmness. His answering tones were just far enough away from Rogan's speech that he could not be accused of Contempt For An Investigator.

"I trust you know, Mr. Rogan, that my subject is psychosomatics. I trust you are aware that I have no knowledge of approved astronomy courses, and would not feel qualified to comment upon it."

Rogan slapped the cartoon on the desk with the back of his fingers imperatively. He had studied the old films assiduously in an attempt to impart authority into his own attitudes and gestures.

"How do you account for this cartoon, then, doctor?" he asked with the triumphant expression of having scored an irrefutable point. The characteristic puerility of it washed away the final residue of irritation on Billings' mind, and he smiled in genuine amusement.

"Why, I suspect young Tyler, its author, is just having a bit of fun," he said slowly. "He's quite a mischief maker."

Rogan's eyes lighted up with delight at the possibility of a new scent.

"A student, eh?" he asked quickly. "One of these subversive cults probably. Trying to undermine our faith in our institutions."

"The cartoonist is young Raymond Tyler, of Tyler Synthetics," Billings said quietly. "An only son of the family, I believe."

"Ah," Rogan's face smoothed of all suspicion instantly. "Just a boyhood prank then." He was obsequious at the very name of such a powerful indus-

try. "Boys will be boys, eh, doctor?"

"This one in particular," Billings said with a heavy note of irony. "Was that all, Mr. Rogan?" There was a note of unmistakable dismissal in his voice. Even Rogan could not miss it. The little man flushed, and pointedly sat down in a chair as his answer.

"No, doctor, that was just a preliminary," he said. "I have a commission for you from Washington. You are to head up a new line of research."

"I haven't completed my old line of research, Mr. Rogan," Billings reminded him. "Inquiry into the reasons for Citizen Neurosis."

"That's canceled, doctor," Rogan said firmly. "Washington is no longer interested in Civilian Fatigue." He reached out for his ornate brief case, fondled it lovingly as he opened it, and drew from it a thick sheaf of papers in a blue binding.

Billings made an impatient gesture, as if to remonstrate that months of work should not be so easily discarded, and then realized the futility of it. He settled back into his chair again.

"Very well, Mr. Rogan," he said in a resigned voice. "What does Washington instruct me to work on now?"

Even after thirty years of it, he was not yet accustomed to universities being operated on sound businesslike principles, with orders coming from the front office telling the boys in the lab what they should be thinking about today.

Or even more than thirty years. It was impossible to draw a hard line on just when it had happened. Perhaps it was the outgrowth of the practice when he had been a research student and young instructor. The local industry would come to the university with a problem. The university was eager to show its co-operation, its practical place in the industrial life of the nation. They got into the habit of delaying their own lines of research and working on those immediate ones required by industry. The habit grew into a custom. A few universities saw the danger and rebelled. Overnight, custom became a law. To rebel against a law, even a bad one, was subversion.

But he must not let his mind wander into the past. That was the mark of senility, they said. And what was Rogan saying now? And why didn't the man just leave the folder with him? Why did the man have to read it to him, word for word?

The opening pages were filled with gobbledegook, replete with such phrases as "by order of," and "under penalty of." Why did these government agencies always feel they had to threaten citizens? He could not recall any government communication which did not carry a threat of what would happen to him if he failed to comply. Surely after seven thousand years of trying it, governments should have learned that threats and punishment were not the way to accomplish their aims.

His eyes wandered around the room, and scowled at the gray November sky outside the window. The cold light made the dark paneled wood of his walls seem dingy and grimed. The shabby, old-fashioned furniture seemed even more shabby as the little man's voice droned on and on through the phrases.

". . . As revised . . . authorized . . . official . . . top secret . . ." Rogan apparently liked the sound of the governmental jargon, and gave each phase a full measure of expression.

Gradually the sense of the order became dimly apparent through all the legal phrasing. As Billings had feared, it was an old problem, just now coming to light.

That was significant, even though only a few men might recognize it. Not one new principle had come out of the universities in the past thirty years. Not one problem had arisen which hadn't been foreseen then. It was as if something geared to tremendous momentum had had powerful brakes applied. The forward movement seemed to continue satisfactorily; yet it was apparent to anyone who cared to look that it was grinding to a halt.

Odd how the human mind, once it became conscious of the unyielding pressure of limits and restrictions, refused to think constructively. There was a lot of loose talk about the indestructibility of the human will, how it strove onward and upward, overcoming all obstacles. But that was just talk, of the most irresponsible kind. Actually the human will to progress was the most delicate mechanism imaginable, and refused to work at all if conditions were not precisely right.

In the half million years man had been on earth, there were only twenty occasions when he had been able to pull himself up beyond the primitive animal level. It was significant, too, that most of these generated their forward momentum in one spurt, and often within one lifetime. Momentum reached its point where rulers became satisfied and clamped down restrictions against any change of the *status quo*. Then began, over and over in each civilization, the slow retrogression and the long night.

In the typical fashion of governmental directives, the order said the same thing over and over, yet never succeeded in saying outright what it meant. Man's inventive techniques had outstripped his reaction time possibilities. A plane, hurtling into an unforeseen disaster, would strike it before the pilot could become aware of the danger and react to avert it.

To protect his own life, man had had to place a limit upon the speed of his vehicles. True, he tried to cope with the situation by inventing servomechanisms, but most of these merely registered their findings upon a dial. The cockpits of ships became a solid wall of dials. No human eye could read all their messages simultaneously and

react as they directed.

And, too, the servomechanisms, intricate and marvelous though they might be, were blind and senseless things, capable of following only one design of action.

Only the human mind was sufficiently flexible to vary the patterns of behavior to meet the variation of possible circumstances. But the human mind was too slow, too inefficient, too easily distorted. It was—an understatement—undependable.

Billings watched the unfolding of the inexorable logic in the order with a growing dread which began to mount to the level of horror. For it was clear to him where the logic must lead. Since we did have weapons, the order pursued its line of thinking, which could seek out a target, follow it, strike and destroy it; the work of Hoxworth University was quite simple, and should require little time or tax monies.

The university was simply required to reverse the known mechanical principle and see that a plane, or an automobile, or other moving vehicle, struck nothing!

The order ended with its usual propaganda. Thus the citizens could see that, once again, out of war came great benefits to peace.

.

Rogan closed the stiff back page of the order and looked up at Billings with an expression of satisfaction at having delivered the government's instructions concisely and completely.

"In other words," Billings said slowly, "they want a servomechanism designed which can foresee the future, and work out a pattern of mechanical operation which will cope with that future at the time it becomes present." He realized his voice showed his incredulity, and that it would displease Rogan. It did.

"I believe the order is quite clear, doctor," Rogan said decisively. "And there is certainly nothing difficult about it, now that Washington has shown you the way to solve it. What a target-finder missile does, you simply have to do in reverse."

"But why did Washington select me, Mr. Rogan?" Billings asked carefully. "I am not a mechanical technician or engineer. I work with the human mind and body, their interaction. I wouldn't know anything about this project at all."

He was sorry he mentioned it, for it could be construed as Unwillingness to Co-operate, a fellow traveler act if not actually subversive. And it was a foolish question to ask, too, since government did not usually take capability into consideration in making an appointment—no more than the people did in electing government. Still, his question did bring him unexpected results.

Rogan hesitated, pulled at his lip, decided not to make anything out of the doctor's slip.

"Washington does not usually have to explain to a citizen," he said, "but

I am instructed to answer you. This project is not a new one. It has been assigned before—several times."

"You mean the mechanical engineers have refused it?" Billings asked.

"Those who did are serving their sentences, of course," Rogan said, and his voice implied that Dr. Billings could join them without loss to the world. "But there was one thread of agreement at their trials. They all said that this would be duplicating the work of the human brain, and we'd better go to an expert on the human brain if we wanted to know how that worked.

"So," he finished simply, "here we are."

Billings had thought he was beyond further astonishment, but he had underestimated his own capacity for it.

"Mr. Rogan," he said slowly, trying not to show that he was aghast at the vacuity of such logic. "I do not question Washington's wisdom. But for the sake of the record, I know only a few of the secondary effects of mental action; I do not know how the mind works; I do not know of any human being who does."

He stopped short, for there flashed into his mind the possibility of one who might. Joe Carter, a student—a telepath.

The house where Joe lived was nearly a century old, and did not need the aid of the fog and the dusk to give it an air of grimy neglect. The weather-stained sign which proclaimed light-housekeeping rooms for students seemed almost as old, but at least it did not misrepresent them as being cheery or bright or comfortable.

Billings hesitated briefly at the foot of the steps leading up to its front door, and mentally pictured with dread the two long flights of wooden stairs he must climb to reach Joe's room.

He could have summoned Joe to his office, of course, but tonight that would have been adding insult to injury. And, too, in his own room, the boy seemed to have a little less reserve than in the office or the classrooms.

He started the slow, careful climb up the steps, opened the front door which was never locked for it was obvious that no one here could have anything worth taking, walked across the short hall, and started up the first flight of stairs. He glanced farther down the hall, saw the landlady's door close abruptly, and smiled. It was the same, every time he came to see Joe.

He had known Joe Carter for twelve years. First there had been the letter from Martin at Steiffel University, telling him about an eight-year-old telepath whose parents thought him insane. He, himself, had gone to the small college town and talked with the boy. He had arrived at a bad time. The story, as he got it from others, was that the boy had picked up a stray dog. The boy's parents had turned the dog over to the pound, and it had been de-

stroyed. Joe had become silent, uncommunicative, unresponsive to any of Billings' attempts to draw him out.

Twelve years. From the sidelines he had watched Joe get through primary and secondary schools. He had marveled at the continued, never breaking concealment the boy practiced in covering his unique talent. But concealment breeds distrust. The boy grew up friendless and alone.

Every year Billings had reviewed the grades which Joe had made. They were uniformly, monotonously, equivalent of C. He was determined to be neither sharp nor dull; determined that he would do nothing to make anyone notice him for any reason. As if his life, itself, depended upon remaining unnoticed.

Both his high school associates and Joe's parents were astonished when Hoxworth University offered him a scholarship. It wasn't much of a scholarship, true, for Joe's parents had no influence and Joe was not an athlete. Since there would be neither prestige nor financial return to the University, it hadn't been easy, but Billings had managed it, and without revealing the reasons for it.

He paused and caught his breath in the hallway at the top of the first flight of stairs, and then resumed his upward climb. They could talk all they pleased about how hale and hearty he was at seventy, but two flights of stairs—

Twelve years. That would make Joe about twenty now. The last three years had been at Hoxworth. And Joe had been as colorless in college as in high school.

Billings had tried, many times, to draw him out, make him flare into life. He had shown infinite patience; he had strived to radiate sympathy and understanding. Joe Carter had remained polite, friendly, appreciative—and closed. Billings had tried to show community of spirit, transcending the fifty years gap in their ages—and Joe had remained respectful, considerate, and aware of the honor of personal friendship from such a famous man. If Joe had known who wheedled a scholarship for him, he had never shown the knowledge.

Tonight Billings would try a different method. Tonight he would sink to the common level of the mean in spirit. He would demand acknowledgment and some repayment for his benefaction.

He hesitated in front of the wooden paneled door, almost withdrew back down the stairs in preference to portraying himself in such a petty light; and then before he could make up his mind to give it up, he knocked.

The door opened, almost immediately, as if Joe had been waiting for the knock. The boy's face was withdrawn and expressionless, as usual. Yet Billings felt there was a greater wariness than usual.

"Come in, doctor," Joe said. "I heard you coming up the stairs. I've

just made some coffee."

Two chairs were placed at the pitiful little table; two heavy china cups wreathed vapor. A battered coffeepot sat on a gas plate. The housekeeping was light, indeed.

The two of them sat down in chairs, straight hard chairs and picked up the mugs of coffee.

"I'm in trouble, Joe," Billings began. "I need your help." Somehow he felt that an immediate opening, without preliminary fencing, would be more appreciated. And on this basis, he proceeded into the story of the newest order he had just received that afternoon from Rogan. He made no effort, either, to draw Joe out, to get the boy to acknowledge his talent of telepathy. Billings took it for granted, and became aware as he progressed that Joe was making no effort to deny it.

That, at least, was hopeful. He switched suddenly to a frontal approach, although he knew that young men usually resented it when an older man, particularly a successful one, did it.

"Have you given any thought, Joe, to what you intend to do with your life? Any way you can turn your gift into constructive use?"

"A great deal, of course," Joe answered without hesitation. "In that, at least, I'm no different from the average fellow. You want me to work with you on this synthetic brain, don't you, doctor? You think I may have some understanding you lack? Is that it?"

"Yes, Joe."

"It could destroy the human race, you know," Joe said quietly.

Billings was brought up short. He felt a sudden chill, not entirely due to the bleak and heatless room in which they sat.

"You foresee that, Joe, definitely?" he asked. "Or are you merely speculating?"

"I'm an imperfect," Joe answered quietly. "I often see seconds or minutes ahead. Occasionally I see days or weeks, but not accurately. The future isn't fixed. But I'm afraid of this thing. I'm afraid that if we make a machine which can think better than man, mankind wouldn't survive it."

"Do you think man is worth surviving, Joe? After the things he's done?"

Joe fell silent, looking down at the table. Seconds became minutes. The cheap clock on the dresser ticked away a quarter of an hour. The coffee in the cups grew cold. Billings shivered in the damp cold of the unheated room, contrasted it with the animal warren comfort of the dormitories, the luxury of the frat houses. He became suddenly afraid of Joe's answer. He had at least some conception of what it must be like to be alone, the only one of its kind, a man who could see in a world of totally blind without even a concept of sight. How much bitterness did Joe carry over from childhood?

"Do you believe that man has reached his evolutionary peak, doctor?" Joe asked at last, breaking the heavy silence.

"No-o," Billings answered slowly.

"Couldn't the whole psi area be something which is latent, just really beginning to develop as the photosensitive cells of primitive life in animals once did? I have the feeling," he paused, and changed his phrasing. "I know that everyone experiences psi phenomena on a subconscious level. Occasionally a freak comes along"—he used the term without bitterness—"who has no barrier to shut it out of the conscious. I . . . I think we're trending toward the psi and not away from it."

"You think man should be given the chance to go on farther, then?" Billings asked.

"Yes," Joe said.

"And you think that if he finds out what the true nature of thought is, at the level he uses it, it would destroy him?"

"It might."

"Why?"

"He's proud, vain, superficial, egotistical, superstitious," Joe said without any emphasis. "This machine, to

do what Washington wants, would have to use judgment, determine right from wrong, good from bad. Man has kept a monopoly on that—or thinks he has."

"What do you mean—thinks he has?" Billings asked, and felt he was nearing some door which might open on a new vista.

"Suppose we say that white is good and black is bad," Joe said quietly. "Any photoelectric cell then can tell good from bad. Suppose we say a high number is right and a low number is wrong. Any self-respecting cybernetic machine then can tell right from wrong."

"But those are purely arbitrary values, Joe," Billings objected. "Set up for a specific expediency."

"You're something of a historian, doctor," Joe answered obliquely. "Aren't all of them?"

Billings started to argue along the lines of inherent human nature, instinct for good and right, basic moralities, the things man believed set him apart from the other animals. He realized that he would be talking to a telepath; that he had better stick to the facts.

"At least man has arbitrarily set his own values, Joe," he said. "The photoelectric cell or cybernetic machine can't do that." Yet he caught a glimpse of things beyond the opening door, and became suddenly silent.

"We must emphasize that fact, doctor," Joe said earnestly. "Man must go on, for a while, thinking that; in spite of the contrary evidence which this servomechanism will reveal. That shouldn't be too hard to maintain. Man generally believes what he prefers to believe. Most evidence can be twisted to filter through his screen mesh of prejudices and tensions, so that it confirms rather than confounds.

Billings felt a wave of apprehension. He almost wished that he had not come to Joe for help on this project. Yet he felt relief, too. Joe, by the plural pronoun, had indicated that he would work on the project. Relief, because he knew that he had no knowledge whereby the problem could be approached. And he believed Joe did.

The illusion of a door opening remained before his vision. There were dark stirrings beyond.

The work did not progress.

It was not due to lack of organization, or lack of co-operation. The scientists had long ago adapted to the appointment of most anyone as head of a project, and they saw nothing unusual in a specialist in psychosomatics being assigned to make up a new servomechanism.

The lack of progress stemmed from the fact that their objective was not clearly defined. Through the days that followed, Billings was bothered, more than he cared to admit, by Joe's warning that the semantics of their objective must be kept away from any con-

cept of duplicating the work of the human brain. Yet that was what they were trying to do.

He was helped none, either, by the several incidents, in meetings, when one or the other of the scientists on the project tried to tell him that was what they were trying to do.

"If you want a servomechanism," Gunther, the photoelectric man, said, "which will make the same decisions and take the same actions as a human plane pilot, then you must duplicate that pilot's mental processes."

"If we are trying to duplicate the processes of human thought, why have no psychologists, other than yourself, been assigned to this project?" asked Hoskins, the cybernetic man.

These questions were not easy to parry. Both of these men were first-rate scientists, and in the figurative underground, among friends who could be trusted, they asked questions to which they expected answers. The line which Joe had insisted he adopt did not satisfy them.

"We must not permit ourselves to get confused with arguing the processes of human thought," Billings had replied. "We will bog down in that area and get nowhere. This is simply a machine and must be approached from the mechanical."

Yes, it was unsatisfactory, for it was precisely the same kind of thought control which had blanketed the country. You must solve the problem, but you are not permitted to explore this and this and this avenue in your search for the possible solution.

Joe, too, was a disappointment. Billings had succeeded in getting him appointed as project secretary. No one objected since the job required a great deal of paper work, carried little prestige, and the pay was not enticing. There would be other students assigned later to various phases of production. Billings made a mental note to assign young Tyler to something which sounded particularly impressive. The undercurrents of that cartoon could not go ignored. Joe's appointment, therefore, seemed natural enough, and brought him into the thick of activity.

But Joe did no more than the recording. Billings found himself in the frustrating position of having engineered the situation so that Joe would be there for question on how they should proceed, but Joe gave only vague and evasive answers. The progress reports, turned over to Rogan for forwarding on to Washington, contained a great deal of wordage and little else. That would keep Washington quiet for a while, since their tendency was to measure the worth of a report by its poundage; but it was also dangerous in case anybody felt he was slipping out of the public eye, and began to cast about for some juicy publicity.

One of Joe's typical answers brought typical results.

"We already know enough to build it," Joe had said firmly. "We've got

all the basic principles. We can duplicate the action of the human brain, at its present level of thinking, any time we want to. Only if we realize that's what we're doing, we won't want to do it. So, on a mechanical level, we simply have to bring all the principles together and co-ordinate them."

That added up to nothing when Billings tried it. Suggestions from various departments, working piecemeal, ranged all the way from pinhead size transistors, to city block long banks of cybernetic machines. Even though they had the knowledge, if they did, to build a separate machine to take care of each possible pattern which might arise in the piloting of a plane, it would create an accumulation large enough to fill the old Empire State building.

In exasperation, Billings called Joe to account in his office. They were alone, and Billings minced no words about the way Joe was dragging his feet.

"Why do you want to build this machine, doctor?" Joe asked abruptly. "You're not afraid of the consequences if you fail?"

Billings had not expected this attack from Joe. As the weeks had passed, he had felt a growing urgency to succeed, but he had not tried to put his feelings into words. To answer Joe, he tried now.

"Every man, who thinks, wants there to be a meaning to his life," he said carefully, for he sensed that this was the critical point. "I've spent my life trying to know, to understand. Everything I've ever learned seems to come together in this one thing. Say I'm looking for a monument, that there should be an apex, a crowning achievement. Every man would like there to be something remaining after him, which says, 'This is the meaning of his life.' "

Joe was silent, and looked at him steadily. Billings realized he had expressed only a part of it, perhaps the most insignificant part. He picked up a cigarette, lit it, and took another approach.

"A civilization, too," he said. "Each one of them has produced some one great achievement, one specialty. They're not all the same and with the same goals. But each succeeding civilization seems to adopt what results it can use from past achievements. It synthesizes them into its own special achievement. Our specialty has been technological advance. Never mind that everything else is borrowed and doesn't fit us—we have achieved that. But what we have achieved could be meaningless to some future civilization unless we give it meaning now. Here, again, this thing would sum up and embody in one object the total of our technology.

"If man's advance is toward a broader intellect, it seems we should sum up his intellect to this point—

if we can, and in our own language, that of technology. It's the only one we speak without an accent."

Still Joe sat in silence, and picked absently at a frayed thread in the drape which hung near his chair. Though he meant them to be constructive, Billings realized that to Joe such arguments were futile, hopeless, destructive. An old man may think with detachment about thousand-year periods of history, and view with little concern the infinitesimal part his own life plays out of all the trillions of people who may live. But a young man is impatient with such maundering. He wants the answers to his own life, the drive which will give purpose to his own acts. And the purpose was there, too, enough to satisfy even—a Joe.

"No man watches happily," Billings said, "while his civilization passes and sinks back into the Dark Ages. Every man has the tragic feeling that it need not happen; that if some eventual civilization is to endure, then why not his own? True, most civilizations had one spurt which made them shine for a while before they flickered out again. But some had several spurts. Some new thing entered the life of the people. They found the energy to meet the new challenge and solve its problem."

Joe's head came up at this, and he stopped pulling at the string on the curtain.

"According to you, Joe," Billings said in final argument, "this thing may destroy man. It may also bump him up to the next step of evolution."

"You'd be willing to face personal danger for that, doctor?" Joe asked suddenly.

The room grew very still. Billings did not answer lightly, for he suspected Joe saw farther beyond the door than he could.

"Yes," he said firmly. "Of course."

That was the turning point in Joe's attitude toward the project, but it had no effect upon the various scientists, of course. They still operated on the basis of a separate machine for every requirement, and the list of requirements was endless.

Superficially, to anyone who had not thought it through, the problem seemed not too difficult, as Washington had stated. A self-aiming gun, a self-guided missile which fastened upon a distant object, plotted its course to intersect the object, and changed its course to compensate for the change in the fleeing object's maneuvers—these should certainly show the way.

And back of that there had been pilotless radio-controlled planes. And back of that the catapult and the bow and arrow.

But whether it was a self-guided missile, or a spear, there was a human mind back of it which had already predicted, used judgment, set the forces in motion according to that judgment.

Human mind? What about the monkey who threw the coconut from the

tree at its enemy? What about the skunk with its own version of the catapult? Well, mind of some kind.

Even the amoeba varied its actions to suit the circumstances. There couldn't be much of a brain in one cell. Yet it did react, within its limits, through variable patterns. Any psychosomaticist knows that every cell has a sort of mind of its own. But certainly a cybernetic machine has capacity for varied patterns, too, according to the circumstances. But preset, man, prechosen! But didn't blind and reasonless environment preset and prechoose what an amoeba would do? Need it be a mind, as we think of mind?

Billings was not the only one whose thoughts went around and around in this vein, exploring the possible concepts; not the only one who found a yea for every nay. All the scientists, singly and in groups, inescapably followed the same train of reasoning; and came up against the same futility. In spite of Billings' instructions to keep their concepts mechanical, if they were to duplicate the results of judgment between the best courses of action among the many courses of action a plane or an automobile might take, then they had to think about the processes of judging, and the nature of choosing.

Unfortunately, each of them had had courses in psychology, absorbed its strange conclusions, allowed themselves to be influenced by its influence on man's thinking. They arrived nowhere in their analyses. They made the mistake of judging it by the other sciences, assumed it had its foundation based in fact; and felt it must be their own fault when its results gave them nothing.

Yet Billings remembered that Joe had told him they knew enough to build the machine. Still, what was the use of the finest watch if one had no concept of the measurement of time? One might build endless and complex speculation on the way its metal case flashed in the sun, or how it ticked with a life of its own against the ear, in the way that psychology and philosophy speculated endlessly and built complex structures of pointless word games about the nature of man.

Billings smiled with wry amusement at the position in which he found himself. He was like a student who has been given a knotty problem to solve, knows there must be a solution but can't find it. For he did not doubt the conviction of Joe's statement.

Like the bewildered student, he went to teacher. He was sincere enough and had sufficient stature that he could disregard the disparity of their ages, positions, experience, credentials. He was not too proud to accept knowledge, wherever he may find it.

"It's inability to communicate with each other," Joe answered his question. "It's like the spokes of a wheel, without any bridging rim connecting

them. The hub is basic scientific knowledge. Specialized sciences radiate out from that, and in moving outward they build up their own special semantics."

"I've heard the analogy before," Billings objected. "It's not a good one; because, if you think about it, you'll see that none get very far out from the hub without the assistance of the others. The concepts of one must be incorporated into the other before any of them can progress very far."

"They use one another's products, doctor," Joe corrected without emphasis. "Whether those products be gadgets or ideas, they're still the result of another's specialized thinking. A mechanical engineer uses the product of the petroleum engineer without more than superficially knowing or caring about how its molecules were tailored. Say the product doesn't work. The mechanical engineer doesn't drop everything and spend a dozen years or so trying to find the proper lubricant. He goes back to the petroleum engineer, puts in his beef, describes the conditions which the lubricant must meet. The petroleum engineer goes away, polymerizes and catalyzes some more molecules, brings back a new sample, and now the mechanical engineer can go a little farther out on his spoke. But he doesn't communicate except at the product use level."

"Then how are we going to get these men to use each other's products, Joe?" Billings asked impatiently. "This thing is all out of hand. It isn't taking shape at any point. The more we think about it the less it resolves itself, the more chaotic it becomes."

He turned to Joe and spoke levelly, almost accusingly.

"You seem to know what needs to be done, but you don't do anything about it, Joe. I counted on you. Maybe I shouldn't have, but I did. It seemed to me that this thing was a solution for you as well as for me. You've never known how to put your talent to use constructively, and you must have wanted that. Well, here's your chance."

He saw Joe's face turn pale, and a mask of no expression settle over it. But his irritation and frustration made Billings plunge in where consideration had held him back before.

"Why can't you do that, Joe?"

"That would mean going into their minds," Joe said slowly, through stiff lips. "Taking over portions of their thinking, directing their actions. I haven't done that since I played around with it as a child, before I realized what I was doing. It isn't right for one human being—and I do think of myself as human—to control another human being."

Billings threw back his head and laughed with sudden relief.

"Joe!" he exclaimed. "You're the living example that special talent or knowledge does not bring with it special wisdom or common sense!

Don't you realize that every time we ask somebody to pass the salt at the table, or honk our horn at someone on the street, or buy a pair of socks, or give a lecture, that we are controlling the thought and action of others?"

"It isn't the same," Joe insisted. "You normals are blind and fumbling and crude about it. You just bump into one another in your threshing about. And you can always refuse to obey one another."

"Not really, Joe," Billings said. "How long would a man last in his freedom if he refused to do the million things society required of him? I doubt if there's much essential difference in the kind of pressure you could bring, and the kind which the whole society brings upon a man. You say we fumble, while you could do it expertly. I think I'd rather have an expert work on me than a fumbler. What is the difference in your planting the thought of what these scientists should do, and my sending them a written order? Great Scott, boy, if you can get them to accomplish this thing, then you must go ahead."

"Whatever I think needs to be done to accomplish it, doctor?"

"Whatever the project requires to carry it to completion," Billings defined, "remembering that this thing can be the solution for mankind, push him up to the next revolutionary rung."

Joe was silent for a little while, and then spoke slowly.

"But they mustn't know. Outside of a man's own isolated field of knowledge, he's as superstitious as all the rest. They've got all kinds of the wildest ideas about how dangerous and evil a telepath might be. They mustn't know. You've got to remember that sanity in a person or a civilization is like a small boat on the surface of an ocean. If the subterranean depths get roiled up enough, the boat capsizes and there's nothing but the storming chaos of madness."

"Is that the way we appear to you, Joe?"

"That's the way man is," Joe said simply.

"Then if you can keep from rocking the boat when you direct their thinking on this project, you can depend on me to keep it secret, Joe." Billings said reassuringly.

"It's perfectly ethical, all right, for me to control their thinking on this project, then?"

"Perfectly all right, Joe," Billings said with emphasis. And he thought he meant it.

The door opened wider.

It was Hoskins, in charge of the cybernetic aspects, who put the general feeling into words a few days later.

"I've often observed," Hoskins said to no one in particular, as several of them sat around the general meeting room, "that you'll be faced with a

problem which looks completely unsolvable—there's just no point at which you can grab hold of it—then suddenly, for no reason at all, the whole thing smooths out."

Billings darted a quick look at Joe, but that young man, busy at a small table over in the corner of the room, did not look up from his job of assembling various reports into order.

Another, perhaps even more significant piece of evidence became apparent, that the men were incorporating the problem into their thinking normally. The thing acquired a name—Bossy. Suddenly everyone was using it. The animal husbandry department had supplied it.

"Anybody who has ever handled cows knows they can be the most onery, cantankerous, stubborn critters you ever saw one minute, and completely gentle and obedient the next," one of the men from that department said.

And that about described their feelings toward Bossy at this time.

Billings had been trying for some time to find a descriptive name, using the familiar method of initials of descriptive words—sensory—apperceptor—indexer—appraiser—comparer—extrapolator—predictor—chooser—activator— He bogged down, not only in that the initials seemed to add up to nothing pronounceable, but the list of terms themselves merely added to the confusion. He, too, called it Bossy. Somehow that was best—for Bossy was, in spite of her contrariness, domesticated, inferior to man, controllable—and gave milk. Quite consciously, he was comforted by the semantics of the name.

Rogan, too, accepted the name. He was a little scandalized, and as yet Washington hadn't given any reaction which would guide his attitude, but unless the meat or dairy industry objected, there seemed to be nothing subversive about it.

A third evidence, stronger than the other two, was that everyone began talking about sensory receptors. They reasoned that if a pilot sees and hears and feels the external world about him, even though instruments are measuring these things more accurately than he can determine them, then Bossy must also have the receptors to bring sight and sound and feeling.

First, as a joke, and then no longer kidding about it, they decided to give her taste and smell while they were about it. And then someone spoke out in the commons room and said they were pikers. They'd give her sight that a human pilot couldn't have, such as radar. They'd give her sensitivity such as no human being could feel—like the seismograph. They'd give her gyroscopic balance that would make the inner fluid of the human ear less than mentionable. They'd give her—

The talk of what they would give Bossy, all the delicate ways man has evolved to detect things beyond the range of his crude dull senses, went on

far into the night.

Sensory receptors were not too difficult to manage. It was rather astonishing, when one assembled them all together, how widely man had already duplicated human sense receptors. For sight, in the human visual range, there was the electronic camera, the light sensitive film of the photographic plate, the selenium cell, and other. Beyond the normal eye range there was radar, and other infrared and violet-light detectors. There was a wealth of sound-sensitive instruments; and a plethora of touch and feel instruments used by industry in product inspection and analysis. The taste and scent instruments were not so well developed, but there were some, and, approaching it through chemical effect, there could be others.

It was common knowledge, too, that all these instruments converted the external senses to electrical impulse—not too far removed from the way the nerves carry the impact of the sense receptors to the brain.

No one seemed to be bothered about what they would do when they got that far; that an electronic camera could pick up light rays and convert them into electrical impulses until it fogged its lenses, but the picture would have no meaning until the human eye viewed it and gave it meaning.

They went about their job, instead, in the way a skilled artisan goes about his—knowing that problems may arise

which he hasn't yet worked out, but also confident that he can handle them when they do arise.

Their work, at this point, was the reduction of size, greater sensitivity, combining the principles of many instruments into one. The human eye contains a hundred and thirty million light sensitive cells. It would be nice if they could get their camera orifices as tidy and sensitive.

Each of the departments put its best students to work on its own problem, until the entire university was coordinated into working on some aspect of the job. The singleness of purpose, the drive for accomplishment was as much as could be asked by any industrialist.

Rogan, too, was caught up in the enthusiasm, and surveyed the activity with a certain approval—for busy hands have no time for mischief. And he found himself with new duties, strange for a Resident Investigator. Hoxworth University did not have all the talent and equipment it needed for this project, not by any means. Rogan found himself assuming the role of a go-between with Washington, requesting, requisitioning, requiring services and specialists not only from other schools, but from industry itself.

Operation Bossy became a familiar term in the administrative offices of Washington, and throughout the industrial and educational life of the nation. As with most other top-secret projects, everybody knew about it and was talking about it. The stories grew with the telling, and Joe's insistence to Billings that it be kept in the mechanical language began to have reason behind it. It was merely another form of the guided missile. No one realized what was really happening, not even the men working at its central core—not even Billings.

Things were happening too fast for that. It was as if the pieces of a giant jigsaw puzzle, cast carelessly upon a table, began to assemble themselves at various places, without much regard for one another, or where each would fit into the whole once the picture was done.

Although no one had thought of synthetic textiles as being more than remotely connected with the project, it was that laboratory which came up with the impulse-storing ribbon. Yet they were the most logical to accomplish this. That field knows probably more than any other how to tailor and alter molecules to suit their purpose. Sound had long been stored on plastic tape; light, too, in photographic plastic.

Without a hitch, Hoskins of cybernetics, began working in the synthetic textiles department, finding in its ability to polymerize and catalyze molecules the ideal opportunity for memory storage units. Again, the elimination of grossness became a major concern, and from the apertures there began to spew a thread, all but

invisible, not more than a few molecules in breadth and thickness, with each molecule tailored to pick up and store its own burden of electrical impulse.

Bossy began to take shape, and, oddly enough, the box took on a faint resemblance to a cow. Perhaps this was mainly due to the two eyestalks which sprouted out from near its upper surface, like horns topped with dragonfly eye lenses. None of this poor human vision for their Bossy. The diaphragm for picking up sound on the front of the box was vaguely like the blaze on on an animal's face, the apertures for air entrance where scent and taste could be sampled were like nostrils.

It was as if there was an unconscious determination to see that the thing remained Bossy.

A stream of specialized molecules poured past each sense receptor, picked up the electronic vibration, combined to make a thread, in the way that a motion-picture film picks up light and sound, so that when played back they coincide, and stored itself at the bottom of the case.

They had not yet arrived at any point where a new basic principle needed to be found. Although, at this point, they had no more than a superior sense-recording machine. The thread could be played back, but that was all. And no one worried about it.

It was music, another unlikely department, who gave the clue to the next step. A note struck on one key of the piano will, through the principle of harmonics, vibrate the strings at octaves above so that they also give off sound. Shouldn't there be a vibronic code signal inherent in each sense stream, so that like things will activate harmonically with other like things? Wasn't that how recognition took place through harmonically awakened association with like experience in the past?

It was.

Outwardly, Bossy ceased to take shape. To codify every sound, every shape, every vibration translated into touch and feel and scent and taste, every degree of light and color density was a monumental task—in terms of detail work, although its organization was not difficult. To translate these into electrical code impulses was difficult. But here again, no new principle was needed. Here again, man had merely the task defining the world in terms of symbol—and symbol in terms of code impulse.

Nor was it too difficult to again tailor the molecules to carry electrical current, which, theoretically, would keep these code impulses vibrating in harmonics with those passing the sense receptor apertures.

And still it was no more than an impulse storage bank. Only in theory was a new impulse activating its counterpart in old impulses. They had no way of testing it in practice. And felt supremely confident that a way would be found.

No one who has not directed a large scale activity, co-ordinated the work of thousands of people and synthesized their results could fully comprehend the mass of work which fell upon Billings and his immediate staff. Many times he felt he had taken on more than he could handle, that the scope of activity had got out of hand. Yet inquiries and suggestions came from everywhere, and many of them were pertinent and valuable.

It was as if the whole academic life of the nation had been swept up in the same urgency which had compelled him; as if men had something to think about which, for the moment, was unimpeded with restrictions and investigations.

Yet, in spite of the weight of administrative detail, he had the feeling that he had full grasp of everything that was happening, and with a clarity of mind he had never experienced before he was able to see the relation of concepts one to the other.

Perhaps it was this clarity which made him call a halt to the coding as it was developing, scrap much of what had been done, and start over. For it should have been obvious all along that identical things receiving identical codes was not enough. This had been the stumbling block of all cybernetic machines in the past. A tabulating pattern combined only identicals. They could combine the symbols for two apples and six apples correctly into eight apples, but when it came across one apple, it broke this out into a separate category, for the latter symbol differed from the former in that the letter "s" was missing. The cybernetic machines in the past had no sense, were not keyed to vagaries of grammar, spelling mistakes, variations which a child of eight would know were not really variations.

A way must be found to duplicate the dull stupidity of the human mind which could not detect differences unless they were glaring, and yet retain the fine sensitivity of the cybernetic machine.

It became apparent that not only must there be a code impulse for each isolated aspect of the external world, there must also be an interlocking code for activation to bring back the total picture. Remembrances are by association, one thing leads to another.

A symbol of a square must not only activate any previous experience of the symbol of a square but also the circumstances in which that symbol was experienced. Yes, there must be a horizontal interlocking of codes, as well as vertical. For was not that the way decisions were made? In terms of how things, similar things, under similar circumstances, worked out in the past?

Much had been written that the patterns of life duplicate themselves again and again and again; that the intelligent man recognizes this duplication even though it may be in a different guise, while the unintelligent

and the machine do not and must solve each thing as if it were new.

While they were setting up the new system of coding, the art department threw the worst curve of all. There was the matter of foreshortening. A square on a card looks square when faced head-on, but looks rectangular if the card is turned at an angle. The human mind learns to make adjustments for foreshortening, so shouldn't Bossy? They asked it blandly, and perhaps a litle maliciously, for they had not been consulted up to this point.

Billings was dismayed at this obvious difficulty, and his spirits were not lifted either by the knowledge that it took over three thousand years of art painting for man to move from the side view of the foot, as portrayed by the Egyptians, to the front view, as discovered by the Greeks. And almost another five hundred years to move from the profile of the face to a front view.

It would be difficult to achieve this for Bossy. Still, there was no new principles involved, simply a coding method which would tell Bossy that one object was truly a rectangle seen head-on, and another which appeared to be the same was really a square seen at an angle. It was the same kind of lateral coding which would solve this.

The key to Bossy's first overt reaction to stimuli came from one of the younger assistant professors one night in the common room. He was ruefully telling how his new baby responded to his wife's hands with contentment and to his hands with fright. The baby was much too young to recognize the difference between mama and papa. It must be familiarity versus unfamiliarity in the manner of touch.

A few days later, safety guards were installed around Bossy. They had long since installed the yes-no principle to be found in other cybernetic machines. There was jubilation and something approaching awe when Bossy demonstrated it could learn—and learn with only one trial. The safety guards were keyed to the reject pattern, but when Hoskins, who installed the guards, depressed the accept key for his own hands, thereafter the machine threw up its guards when approached by alien hands, but left them down for Hoskins' hands. Perhaps it was mass, or shape codes. Perhaps it was color. Perhaps it was scent, for Hoskins had been working around the machine when scent codes were being fed into it. Still Hoskins had no code of his own scent as differing from others. Scent was out, for the machine had no equipment whereby it might do its own coding.

They were not sure just what process had occurred which made Bossy distinguish safe hands from unsafe hands. She had the sense receptors to observe the outside world. She had the codes, a great many and more being added constantly, whereby through

keyed harmonics she associated new perception with old. Some moves had been made to key her with similarities and differences. The mechanism was there to compare the new with the old and to determine the identities and the differences. And now she had demonstrated that she could distinguish through the sense perceptors and the established coding.

Further, she had demonstrated that she could take automatic action.

The men cautioned one another, again and again, that they must not fall into the habit of thinking the machine could do anything they hadn't keyed it to do. It had no sense. None at all. Really, this throwing up the bars to keep alien hands out was no more than any selenium cell would do—well, modified by coding.

Even without Joe's warning glance, Billings felt they were reassuring one another on this point perhaps a little too much. He noticed, too, that the gender changed overnight from it to she. But it was several days before he noticed that Gunther had begun to stammer the name to B-b-b-ossy, each time he said it, although the man never stammered on anything else. And Hoskins always hesitated with an audible "ah" before saying the name.

The shadows beyond the door began to stir and swell, and seemed to writhe around one another.

Spring came, and then it was June. Commencement exercises were no more than a reluctant interlude from the work. Billings watched Joe throw off his graduating cap and gown, and in almost the same movement start assembling the requests for student deferments from compulsory military service. A summer session extraordinary had been declared that no time be lost in the work on Bossy, and the entire university was humming on a factory schedule.

A new respect had been gained for a baby's mind. Ordinarily adults thought of the newborn baby as just lying there, inert mentally, accomplishing little learning beyond finding out that a cry would summon attention, a nipple placed between its lips would start the reflex of sucking. Now they realized the multitudes of unrelated sense impressions that mind must be storing, the repeated patterns which impressed themselves upon its brain—and prediction of the future.

"If I cry, there will be approaching footsteps. I stop my crying to listen for them. If I do not hear them, I cry again. Soon there will be comforting hands and I will be dry and warm again."

And any young mother knows this is accomplished in a few weeks. One by one the patterns are learned, the sensation relationships repeat themselves, a word is spoken in connection with an object or an action. Always the word and the object appear simultaneously—they are cojoined, one produces the other. Relationships become

vaguely apparent. Cause and effect emerge as an expectancy.

If it were not that a baby was human, one might set up certain laws of procedure. An outside world datum makes an impact upon a sensory receptor. This is accompanied by other impacts of other data. There is a relationship of each to the other. And long before there is any concept of self, as an entity, there is a realization of self to the data. Not all the data appear each time and in the same order. But if enough data appear to strike up the harmonics of association with a previous experience—judgment is assumed. Through repetition of patterns of trial and error, some reflex and some calculated, action upon judgment takes place.

But the baby is human, and therefore mysterious, and we may not simplify the awful metaphysics of an awakening human mind into a set of mechanical steps. The human mind is set apart, the human mind could not contemplate itself as being no more than an operation of an understandable process.

But it was different with Bossy. Bossy was a machine, and therefore the processes which would substitute for thought must be approached mechanically. Bossy recognized solely through mechanical indexing—no different in principle from the old-fashioned punched card sorter. This and this and this is the same as that and that and that—therefore these two things have a relationship to one another. Comparison of new data with old data, a feedback process of numerous indexed impulses and these to the external sense receptors and their stream of new impulses—really it was quite trivial.

It was only coincidence that it seemed, here and there, to duplicate the results of an infant mind. Only coincidence that as new experience and new data were being constantly applied, new areas of experience exposed to Bossy, that she should seem to follow the process of the learning child.

Strictly coincidence, and one must not be fooled by coincidence.

As Billings watched Joe assemble the lists of deferments, he wondered about the young man. Since their conversation, when he had asked Joe to use his talents to further the project, they had talked no more than the work required. Billings was no closer to knowing Joe than he had ever been, and Joe volunteered nothing. He did not know what Joe had done to clear away the mental blocks which had prevented the scientists from grasping the problem, he had only the overt evidence that something had been done.

Really this project was all he had claimed it would be. Attempt to reduce it to simplicity though they may, it still remained that all of man's science up to the present had been required to produce it. Bossy's accomplishment

was for all time the monument to the triumph of science, the refutation that science exists only through the indifferent tolerance of the average man, the refutation also that man has never used his intellect except to rationalize, justify and decorate with high-sounding phrases the primitive urges he intended to foster anyway. For it had taken intellect to produce Bossy, intellect of a high order, reaching up to —detachment.

"Oh, by the way, doctor," Joe looked up from his work at the desk and interrupted Billings' thinking, "have you been following the articles on witchcraft?"

"Why . . . why no, Joe," Billings answered. "I hadn't noticed. What about them?"

"There's a trend," Joe said. "At first the articles started out faintly deploring, and then explaining. Now there is the current theory that scientists and thinkers generally tend to get off the right track. That there is a mass wisdom for doing the right thing for mankind, embodied in the masses of people. That mankind has proved steadily and progressively he knows what is best for him; and therefore the so-called witchcraft suppression was simply man's way, an instinctive inherent rightness, to keep from being led into the wrong ways of thinking."

"That is a very common line of thinking," Billings said without much interest. "How are you coming along with that roster of deferments?"

He saw Joe throw him a quick, appraising look, and then turn back to his work again. Probably nothing significant about Joe's remarks. Young men tended to become much too horrified as they realized the terrible stupidity of mankind. As one grows older, one doesn't expect so much; loses some of the idealism of what man should be.

"It's pretty extensive, doctor," Joe said in a colorless voice. "When I think that a similar list is being prepared in every college throughout the country . . . well, the military isn't going to like not being able to harvest its new crop. There'll be an investigation."

Billings hardly heard him. His mind continued along the track of comparison of Bossy and a child. Every day new sensations fed into the child, new admonitions, corrections, approvals, patterns fed into stored accumulation of past sensations and conclusions. Sensations on the order of billions, perhaps trillions—no wonder that thought seemed complex, ungraspable. But as with so many problems the difficulty was size and bulk—and complexity was no more than superimposure of simple upon simple.

But human beings did not learn fast, most of them required many repetitions of a pattern before they grasped it. The man was rare, indeed, who could memorize a book in scanning it once. Really now, a very poor job had been done in tailoring the

molecular structure of—

Bossy required only once. Perhaps Joe was right. Perhaps man was still evolving. Perhaps his brain was no more than a rudimentary light-sensitive cell as compared with the eye. Perhaps that was why his brain gave such a poor performance, it had not evolved into its potential.

Billings sat, gazing out of the window at the elm trees and the sky.

"Yes," he murmured, moments later to Joe's comment. "No doubt there will be an investigation." He wondered, vaguely, what there would be an investigation about—but no matter, there were always investigations.

Surely it would have nothing to do with Hoxworth University, or himself. For the assignment had succeeded beyond the wildest imaginings. Perhaps it was immodest, but surely the success of Bossy would be emblazoned across the pages of history for a thousand years—the greatest achievement of all time; and his name would be that of its author.

Man! Know thyself!

"We must not allow ourselves to become fascinated with the sensation mongering of these investigations, Joe," he said chidingly. "We are thinkers, and we have work to do."

Again he felt the quick, questioning look from Joe, but dismissed it and continued with his development of vision. Plainly, Joe still lacked wisdom.

Through the weeks that followed another tension began to assume proportions too great to be ignored. As long as there had been such a recognized thing as science, itself, there had been a controversy concerning one aspect of it. A thing is composed of numerous properties which a theory or an equation must take into account if a satisfactory solution is to be attained. Some of these properties are intangible, but none the less real, such as friction, or gravity. Some are still variable and unpredictable. Thus one of the real and inescapable properties of a thing is—human reaction to it. An automobile could not be called a satisfactory invention if no one would drive it; an electric light could not be called a solution to illuminating darkness if man smashed it in frenzied rage each time he saw it. Since man can know a thing only through the mind of man, then the mind of man is one of its inherent properties. So said a school of philosophy.

This pro school held that human reaction to a thing was as real as gravity or friction; that a scientist who ignored it was like a mechanical engineer who persisted in ignoring the effects of friction, a structural engineer who ignored gravity. On the con side, it was considered that the physical scientist had plenty to do in measuring physical forces and properties; that the force of human reaction, if it existed, belonged in someone else's problem basket.

The pro school held this was not true; that the pharmaceutical chemist did assume responsibility for the effect of his concoctions upon human mind and tissues, the structural engineer did assume some responsibility for the end use of his houses or bridges, the mechanical engineer did assume some responsibility for people using his motor; that no arbitrary line could be drawn separating responsibility from nonresponsibility.

The con school, in the vast majority because it is easier to evade responsibility than to assume it, still passed the buck.

And because this real property of things continued to be ignored, the gap between the scientist and the man in the street widened, and widened, and stretched out farther and farther. Any physical scientist knows that regardless of theory, there is a practical limit to the elasticity of a material. There is also a limit to the elasticity of human reaction to a science it cannot understand, and therefore fears.

It became also apparent, in these weeks, that there was a serious leak of details on the progress of Bossy. No project as widespread as the work on Bossy could be kept entirely under security. Even where trained scientists possess only scraps and portions of the whole knowledge, misconceptions will occur. And multitudes of those working on some phase of Bossy were not yet trained scientists. They were students. Students, for all the grave respect they hold for the weight and importance of their knowledge, are notorious for misconceptions. There is a dividing line between effective scientist and student, but it has nothing to do with graduation exercises. Too many remain students, multiplying misconception upon misconception. An astonishing number of these, unable to make their way in the laboratory, turn to teaching for their living. The gap between science and superstition widens.

Beyond a serious central leak, which was becoming apparent, there were widespread rumors and bits of information leaking out. Each, in itself, was perhaps a harmless thing—if properly weighed and stripped of its exaggerations and misinterpretations. But human beings, generally, are not noted for their ability to weigh judiciously, discount exaggerations, and allow for possible misunderstanding. People like sensationalism, and in the telling add their bit to it.

Bossy, at first ignored as being the business of the scientists and having no relationship to bread and bed, suddenly became a topic of conversation everywhere. Everyone found he had an opinion. Ready-made opinions by the score poured through the news columns and over video. Bossy began to assume proportions of concern, dread, then outright fear.

When you stop to think of it, some of the more articulate would say, the

most inefficient, unpredictable, costly and exasperating machine used in industry is the human being. The only advantage it has over other machines, the only reason an industrialist uses it, is its wide flexibility of adaptation to numerous conditions, the ease of replacement if it doesn't function properly.

But now there was Bossy.

It did not take long for the sensationalists to predict manless factories, manless shops and stores, manless utility and transportation services. Once the coals were breathed into flame, it did not take long for the fire to gather fuel and spread in white heat. And like a gasoline poured into the flames was the wholesale student deferment.

Some of this reaction trickled, much diffused, into the ivory towers. Billings tried to offset it. He made a personal appearance on a national hookup, but he mistook fire for water and poured oil on the waves to quiet them.

"There is nothing to fear," he said. "The brain of Bossy is no more than a compound of synthetic proteins, colloids, enzymes, metallic salts, fatty acids—each molecule designed and shaped to do a specific task, picking up codified impulse charges to complete their structure, and then combining into a threadlike substance for storage and release."

If he had spoken in Hottentot, it would have been as comprehensible and less dangerous. For without conveying the slightest understanding, and even in his attempts to show this thing was not human, he heightened the dread.

Bossy was truly a machine, a synthetic thing. Its inventor, the famous Billings, had said so, himself. Had it been alive, man might have understood it better, even though alien and inimical it would have shared with him the mystery of life and thought.

As he droned on and on through his talk, as he described the lenses, the diaphragms, the metallic, glassite, plastic receptors, showing how they saw and felt and tasted and heard, he confirmed all the rumors. Bossy *was* capable of replacing man.

And Bossy had no soul.

Letters by the thousands, the hundreds of thousands, poured into Congress. Congress, far more receptive to the will of the people than is generally realized, tried to act. But it was the Administrative Department who had cut the orders for work on Bossy. The Administrative Department unfortunately chose this issue as a battle arena to show Congress it could no longer be shoved around so easily. The resultant conflict, the raw tempers which flared into print and over national hookups, served merely to heighten the tension throughout the country. There was something to it!

The quiet and doubtful words of the mollifiers, the advocates of let's wait and see, the admonishers of you're

not hurt yet, their voices were lost in the angry outpourings of revolt against this manufacture of a soulless machine to replace man, this deferment of favored young men, these irresponsible scientists—science itself.

In damning the very idea of science, it never occurred to most that they were using the products of science to get their message into every corner of the land, into every mind.

The first overt move came from a small band of men who chose to have a parade of protest. It was national news. They fed upon the publicity. The parade regrouped and formed into a march—a march across two states toward Hoxworth University. The ranks of the marchers swelled. Other marchers started.

And in the village of Hoxworth, near the university, the residents decided they did not need to be reminded of their duty by people from other communities.

There sprang from the mind of a fanatic, and couched in the lyrical language so often used by the psychotic, a huge placard that was set up at the corner of the library park one night. In one corner of it, there was a copy of young Tyler's cartoon of Billings. And in bold lettering:

HIDE! HIDE! WITCH! THE GOOD FOLK COME TO BURN THEE!

All day there was a crowd around it. In the strange manner of disturbed people, some stood for hours just looking at it, letting its message seep into the bottom fibers of their beings—awakening ancestral memories.

But during the small hours of the night, some student, perhaps equally psychotic in his bitterness against such medieval reaction, added another placard below with these scornful words:

THEIR KEEN ENJOYMENT HID BENEATH THE GOTHIC MASK OF DUTY!

It was a most unfortunate thing, for it struck deep into the roots of guilt, and even where some had hung back, now they raged and stormed with the rest when it was discovered the next morning.

A pall of quietness, inactivity, hung over Hoxworth University. A miasma of gloom, apprehension, like the somatics within a prison, filled the grounds and seeped through the halls. Classes were sparsely attended, and instructors found themselves straying away from the subject of their lectures. Most of the students had gone home in the weeks before.

All work on Bossy had ceased at the orders of the Board of Governors of the University. She had been dismantled and her parts stored away. The activated brain floes had been carefully lifted out of its case and folded into a thin aluminum box. No one was sure what damage even this handling might do, and no one had the

urge to test and experiment to find out.

"I tried to warn you, Dr. Billings," Joe said once, in the dean's office.

"But if you knew this, Joe!" Billings exclaimed. "Why didn't you tell us?"

"Each time I tried, doctor," Joe said quietly, "you told me to mind my own business, that I lacked wisdom. I didn't know for sure what would happen, or I'd have forced you to listen. I knew only that men of science have failed to bring the people along with them, that human beings are capable of terrible things when they are terrified. You told me, many times, that scientists are not concerned with these things; that scientists don't want to hear about doom consequences; that scientists are quite certain everything will be all right if they're just permitted to do as they please."

"People have predicted doom at every single advance of science, Joe," Billings admonished him. "Look at all the doom written around the time of atomic discovery. It never happened."

"I know," Joe said. "It's a case of 'Wolf, wolf' being cried too often, isn't it? Too bad. But your history should tell you, doctor, there always comes a time when the wolf really does come."

There wasn't any more conversation along this line. There wasn't anything more that either of them could say. Joe went back to his work at his desk in the corner of the room, trying to fill in the new batch of questionnaires Rogan had received from Washington. Rogan had taken them from his silver incrusted brief case, wordlessly, and laid them on Joe's desk. Rogan was as grim and apprehensive as all the rest. He had followed orders all the way, but it had gone wrong. Rogan could see only one thing; he would be blamed for it all—and yet he had merely followed orders.

Billings was a little glad when Joe finished his work and left the room. He realized he had been stupid. He had had an instrument at his hand, a delicately tuned instrument capable of picking up facts far beyond the range of his own senses, Joe, a telepath, and he had chosen to ignore the readings of the instrument, to depend upon his own crude and dull senses. The guilt of his stupidity weighed heavily upon him. He was glad that Joe did not like to look into the mind of a normal. He hoped Joe had not looked too deeply into his. The vague discomfort he felt when Joe was around was heightened now.

He sat behind his desk, alone, and reflected with profound disappointment upon scientists, collectively and individually, himself included. They could tear apart the atom and milk it of its strength, they could reconstruct the molecules of nature and improve upon them, they could design instruments far beyond the range of man's senses, solve the riddles of the

universe, and, yes, reconstruct the very processes of thought.

Yet they were powerless against the most ignorant of men: Against the most primitive flares of superstition and dread of the unknown, they had no defense. Weakly, in such a situation, they would try to explain, to reason, to appeal to rationality and logic—against minds preset against all explanations, never having learned reason, alien to rationality and logic.

Was this intelligence? To use against one's most bitter foe a weapon which they knew, in advance, would not touch him?

And knowing that, knowing the potential of it which is always present, still they said with impatient superiority, "Spell us no evil consequences of our acts. We are tired of hearing about doom."

A fresh newspaper, a regular city daily, had been laid on his desk. He pulled it toward him, flipped open its pages, and looked at another cartoon of himself. Yes, it was signed by young Tyler—but a glance showed it had not been drawn by him.

And suddenly he knew where the central leak had been. Young Tyler had been in the thick of everything; but young Tyler was a violent and arrogant young man. He seemed to thrive on trouble, to generate it, to know that in mischief or crime itself his father would rescue him. Billings had been blind to that potential, too.

The central figure in the cartoon, himself, was drawn in massive impressiveness, almost Michelangelo in treatment, dressed in classical flowing robes, holding Bossy up in one hand, and surrounded by a glowing nimbus. The cartoon needed no title nor identification.

Every expert line of it was innuendo —Billings' pretense at nobility, transcendency. Every expert line revealed the blasphemy. In it was the age-old message that it was forbidden to eat of the tree of knowledge, to reach for the stars. In it was the stern admonitions driven into the innermost fiber of almost every child's being.

"You're too young to know! Keep your hands off of that! Mother and Daddy know best! That's none of your business! That's over your head! Wait till you're older! That's too deep for you to understand!"

The message of defeat, weakness, dependency upon higher authority, driven in day by day and hour by hour into the child's basic structure of reaction. And to offset that solid bedrock, a few mumbling teachers said occasionally that the child should think for himself.

It was no wonder that there was a suppressed desire in most small boys' hearts to burn down the schoolhouse which tried to make them learn, when their whole world and all that was safe in it had been composed of not learning. When the very act of knowing, meant punishment. "You *know*

better than to do a thing like that, young man!" And the obvious conclusion drawn by the child, "If I didn't know better, I wouldn't be punished."

What could be done when the very act of knowing brought penalty?

In anger, Billings crumbled the paper and threw it in the wastebasket. It occurred to him that, in like manner, he had just crumpled his whole life and thrown that, too, in the wastebasket. He leaned forward and flipped on his desk radio. He listened, almost without comprehension, to a trained and professional rabble-rouser shouting into a microphone, down in the village below.

". . . Torn stone from stone . . . so that we may wipe out this evil from our midst. . . . Let us not wait for others to show us our duty . . . let us march upon it . . . now . . ."

"What a miserable string of worn-out clichés," Billings murmured in amusement. Then he realized, with a shock, they were talking about Hoxworth University.

He flipped off the switch, cupped his chin in his fingers, and stared at the wall.

Well, let them come. It didn't matter. Nothing mattered. He smiled in self scorn when he realized he could say this because he was quite sure they would not come, that reason would prevail, always prevail.

How unrealistic can a man get? What guarantee was there that they would not come? Had man's basic nature changed since yesterday? What had happened before would happen again, in endless repetition. The cycle would repeat itself.

Primitive man, who knows no step taken beyond that of his father's—the bright and courageous dawn of reason—the rise to a comprehension beyond that of his father's—the brief hesitation at the height of the cycle when sanity and rationality soared—the beginning of the downward curve of revolt against sanity and rationality—the retrogression of comprehension—the final dying embers of reason—and, again, the primitive man who knows no step taken beyond that of his father's.

The circle was endless, enduring on and on for a million years now since dawn man emerged. It would endure on and on for—

How long?

Was there no solution? Was man doomed to follow in the circle endlessly, like a two-dimensional animal bounded by a carelessly thrown thread, unable to conceive of a third dimension whereby it might change direction and crawl *upward?*

Was Joe's idea the right one? That man was just biding his time, slowly evolving, that psionics would mark the next stage, that it was a spiral and not a circle? He must talk further with Joe about this. Now, for the first time, perhaps, he was prepared to listen to something he had not thought

of himself. Had he been like the kind of scientist he scorned, refusing to listen to anything which did not fit in with his already formed conceptions?

Outside his windows, the elm trees rustled in the rising breeze of night. It had grown quite dark. Yet, there in the distance down the hill, was the glow of a light. It was a flickering, leaping, orange light, in the direction of the library park. The light grew brighter in the darkness—as if flames were mounting. Faintly, on the rising wind, there came the murmur of a crowd noise.

He wondered, idly, what the occasion was among the villagers, what they were celebrating, what was the reason for such a huge bonfire. For some strange reason, the placard lines leaped into his consciousness. He connected the lines, the bonfire, with the radio speech.

His head slumped forward on the desk.

He did not hear the door open, or see Joe's grin fade to quick concern. Quickly Joe darted across the room, felt Billings' pulse, put his ear to Billings' chest and heard the heart still beat.

"Just fainted," Joe said to Hoskins, who had come in behind him. "We'll have to carry him. We can't wait any longer."

"Fool thing to delay this long," Hoskins grumbled. "Don't know why you stalled, Joe."

"He had to grow up," Joe said cryptically, and began massaging the flesh at the back of Billing's neck.

Billings came out of his shock coma at the handling, and stiffened his head.

"That's better," Joe grinned. "Come on. Let's get him out of here. We've got work to do. Science isn't licked yet, not by any means." He turned to Hoskins. "You sure you've smuggled all of Bossy's parts out of here safely?"

"Sure, I'm sure," Hoskins grinned back at him. "You sure you've got a safe hiding place for us?"

"Sure, I'm sure," Joe said.

Billings stood up then, and suddenly he was quite strong.

"All right, Joe." Billings shook his head dazedly. "Making a mistake isn't too bad, I guess—if you live long enough to learn from it, and do something about it. Science has had a lot of knowledge, but mighty little understanding.

"Let's go find out what *that* is."

THE END

ILL WIND

BY LEE CORREY

A man is a fool if he seeks to exceed his limitations — and equally a fool if he denies he has them. But psychological limitations are harder for us to recognize!

Illustrated by Freas

The warning bell was ringing, but there was nothing he could do. The test ship was running away, and he lay pinned to the couch by the high acceleration.

Then, his eyes hurt in the morning light that was streaming through the window. The warning bell resolved itself into the jangle of the telephone.

He sat up—and wished he hadn't. His head was one big ache, and his first impulse was to lie down again. But the ringing of the phone was akin to someone tapping on his head with a sledge. Without bothering to put on slippers or robe, he crawled out of bed and groped his way to the phone. "H'lo," he said thickly into the

mouthpiece.

"White Sands Spaceport calling person-to-person Captain Dan Blaine," the voice of the operator intoned.

"Dan Blaine speaking."

"One moment, please."

Wonder what they want? he thought, hooking the leg of a chair with his foot and dragging it over. He sat down promptly, feeling terrible. His headache wasn't getting any better, and he wondered for a moment what had happened.

It came back to him slowly. He remembered Dave calling him last night. "I'm just about to lift ship," his twin brother had told him. There had been a strange elation in his voice. "But I wanted to tell you before anyone else. Jeanie said O.K., and we set the date this afternoon. Will you be my best man, chum?"

Dan hadn't answered, but slammed the receiver down. He didn't remember how long he'd sat there, stunned, baffled, and cut to the core.

Jeanie was his! *Had been* his! What right had that stupid twin brother of his — ?

He'd acted on impulse. The drive south he remembered but vaguely. He knew he'd started the night off in the first place he could find after driving through the Rio Grande Tunnel to Juarez, and he recalled that he'd ended up drinking *tequila con sal y limón* at five cents a shot in some dingy little dive on the Sixteenth of September Street. After that, it was blotto; he didn't even remember how he'd got home to Las Cruces. Somehow, he was back, but he felt like he'd been through a fuel pump.

"Go ahead, please," the voice of the operator brought him abruptly back to reality.

"Hello, Dan, this is Pete Schneckle at Operations. Can you get out here and get ready to lift ship at once?"

"Huh?" Dan said, groping his way up out of the fog that threatened to close over him again. "Pete, you must be mistaken. I wasn't due to test hop the *Ares* for two days. The ship won't even be out of the shop until tomorrow . . . or did I lose a couple days somewhere?"

"The *Ares* is ready now," the Operations man cut in. "We worked all night on her."

Dan's head cleared a bit; he sat up quickly. "What happened?"

"The *Zeus* blew up as she was warping in to the space station."

His stomach did cartwheels the way it always did when he hit free-fall. Dave had been the pilot of the *Zeus*, one of the four spaceships serving man's first artificial satellite. "Dave . . . how is my brother?"

"We don't know. Communications on the satellite went out five hours ago. Their solar power plant went out of commission, and their batteries ran down. When the *Zeus* blew, she took a whole section of the satellite with her and damaged the *Apollo*. The boys

are stuck up there without any power or air. They're living in spacesuits until we can get a ship up to them . . . and they're only good for another twelve hours. We've been trying to get hold of you for hours, but we couldn't find you —"

"I wasn't where I could be found."

"And the phones are all fouled up. Some of the lines are down."

"Huh? Why?"

There was a momentary pause. "I can see you haven't stuck your head outside this morning," Schneckle remarked. "The New Mexico 'monsoon season' is in full swing. We've got winds of steady sixty miles-per-hour out here with gusts up to seventy-five, and the visibility is down to a hundred feet with all the sand and dust blowing."

Dan was suddenly conscious of the wind howling around the apartment windows. He didn't say anything.

"Hello, Dan? Are you still on?"

"Yeah."

"Will you come out right away?"

"What's the matter with the boys in the *Athena?* She's available, isn't she?"

There was another pause before Schneckle answered. "The *Athena* went into the Jornada just before you test-hopped the *Goddard* back from Australia. The *Ares* is the only ship ready to go, and you're the only pilot—"

"What happened to the scheduled pilot for the *Ares?*"

"The doctors down-checked him on reaction time in the centrifuge. He wasn't fast enough to handle a ship lifting in high winds."

"Repeat the local weather," Dan said. Schneckle did.

"That what I thought you said. Sorry, Pete. I'm just a test pilot. I've never lifted a ship in winds like this before. I'll fly any ship ever built, Pete, but I want to pick the circumstances. In a wind like this, the *Ares* will weathercock and splatter all over the Basin. Call me when the wind lets up; I've got a hangover to beat into submission." He slammed the phone back on its cradle and dropped his head in his hands.

The phone started to ring again. He gritted his teeth and ripped it from the wall.

"What do you think I am?" he yelled at the frayed end of the cord. "A hero or something? Well, I'm not taking this one! Think I'm going up there to bail him out of his own mess so he can come back and marry Jeanie? Think I'm that much of a fool? Nuts!" He flung the phone into the center of the floor and staggered back to the bedroom.

Back in bed, he listened to the wind howl around the windows. There was a layer of orange-brown sand on the sill. Typical New Mexico spring weather: winds blowing sand so bad that you could look up and see gophers digging their way down through it.

He knew what it would be like to lift a ship in winds like that. A spaceship rises slowly at first, and, until it gains aerodynamic stability through speed, is extremely unstable. The wind pressure would weathercock the great beast before it had risen ten feet. It was a long chance to take.

His thoughts turned uneasily to the hundred men marooned up there—living in spacesuits, waiting for their air to give out, watching for their salvation in the form of the *Ares*. He felt pretty bad about that, and wished the circumstances could be different. His decision meant that they were lost—and his brother with them.

His brother! He growled at the thought of his twin brother. That stupid, bumbling jerk who never knew what he really wanted, who was so all-fired careful of things which never bothered Dan a bit, who wanted to make sure of *everything* and plan things to the last letter, and who wanted to take only calculated risks. Well, now the world would know what a bungler he really was. Let him plan his way out of this one!

As far as Dan was concerned, this was a form of ironic justice. Hadn't he always been the better pilot? Hadn't they given him the difficult job of testing the ships? Hadn't he made higher scores in the mechanical, mathematical, and intelligence tests than Dave? Didn't he have faster reaction times and g-tolerances? Didn't he always pass the centrifuge tests with the highest ratings of anybody at the Sands?

Wasn't he the better man in spite of the fact that Dave had had all the luck? All through training, Dan had aimed for the scheduled runs; it had just been pure luck that Dave had made it, and left him the job of testing. But Dave's luck had gone on; in quick succession, he'd been given a master pilot's rating, the biggest and most powerful of the spaceships servicing the space station, and the first chairmanship of the League of Space Flight. And the peak of Dave's good luck had left his brother sitting in the street, trying to figure what truck hit him:

Jeanie.

He wasn't going to let Dave take her away from him! He loved Jeanie; his whole life had been wrapped up in her for sixteen months. Jeanie understood him, sympathized with him, and shared his problems. Now he knew she'd been leading him on; she'd decided on Dave for a husband.

Dan thought violently: *Let him sit up there and rot!* His headache was getting worse.

But, if he didn't go, what would be his future as a pilot? Would Jeanie have him if she realized he'd let Dave die? Was the weather a good enough excuse? He tried to weigh the consequences of his nonaction.

He knew he was the best test pilot they had. They were short of pilots now, and they'd need somebody to

run the scheduled ships. Jeanie probably wouldn't have him, but he wasn't sure he wanted her after the trick she'd pulled.

And any fool could see that the weather was too bad to get a ship off the ground.

Deciding that food might help his condition, he went into the tiny kitchen and had a shot of grapefruit juice. The bitter taste served to clear his head a bit. He had the eggs done to perfection and was about to attack them with a fork when, over the howl of the wind, he heard a knock on the door. He ignored it; visitors were the last things he wanted right then. But the door flew open, letting in a gust of wind and a slender girl with wildly flying auburn hair. Her face was blotched with crying, and she hadn't bothered to repowder her face where tears had made tracks through her makeup. She got the door closed with difficulty and stood against it, brushing back her hair.

"Dan! Are you going after him?" she breathed heavily, a touch of panic in her voice.

He sat back down. "Look outside, Jeanie. You can't lift a rocket in winds like this."

His answer froze the girl. It was a moment before she spoke. Then, she came over to the table and leaned on it. Her tone was one of amazement. "You . . . you're not going up?" She said it as if she couldn't believe it.

"That's right."

"But Dave is up there! Your brother!"

He shrugged. "I can't help it. Look, Jeanie, this wind is deadly. The planes are on the ground; the copters are on the ground; the spaceships are on the ground; even the birds are on the ground—provided they're hanging on tight."

Jeanie worked her mouth as though she were trying to say something. Then she noticed the phone on the living room floor. Striding in, she picked it up and surveyed the torn cord. "They've been calling you, haven't they?" She didn't wait for an answer. "The men at White Sands think you can do it, don't they? Why did you turn them down? What's the matter with you?"

"White Sands is faced with an emergency," Dan replied sourly. "Washington has probably landed on them. They're grasping at straws. They'll do anything to make an attempt—even crack up their last serviceable ship. Well, I'm not going to be their goat. I'm no fool—"

Jeanie dropped the phone. Her eyes suddenly blazed, and her voice whipped out in anger as she began to size up the situation. "If the lives of your brother and a hundred men mean nothing—!"

"I don't feel any better about this than you do, Jeanie."

"I don't suppose," she countered, returning to the table, "it would make any difference if Dave and I weren't

getting married, would it?"

"It wouldn't."

"Liar!"

Dan got up and lit a cigarette with studied calmness. "Look, Jeanie, I loved you and I still do—even enough to want to marry you. You had a choice, and you made your decision. I'm not foolish enough to try to change your mind. So . . . I suggest you don't try to change mine." He drew deeply on the cigarette. "How about a cup of coffee before you have to go out in the wind again?"

"Thank you. No." She stepped to the door and paused. Her anger was merged with sorrow. "I should have suspected this, Dan. It's typical of you. It's one of the reasons I chose Dave. I loved you too, Dan, but it was different. You'll never understand, just like you can't understand life. You're a baby, Dan; you've always been a baby, a little boy! One of these days you're going to grow up and see. And you'll discover that Dave was a man."

"*Get out of here!*" he roared, but she was gone.

He had no appetite for the rest of breakfast. The wind played a dismal tune as it howled around the windows. He slumped into a chair in the living room and tried to puzzle things out.

The consequences were going to be worse than he'd suspected, he discovered. But he was still leery of that wind. In the hope that the meteorologists were predicting a letup, he turned on the TV to get the latest news.

The newscaster was disappointing. "With winds of sixty miles an hour continuing into tonight, White Sands weather men say no relief is in sight. This is typical weather for this part of the country during the first three months of the year, and they can give no prediction of a break in the present gale-force winds.

"In a statement just released, White Sands officials have stated that there is a good possibility a ship could get off the ground with an experienced pilot at the controls. White Sands Operations is ready to let a ship take off at any time. The spaceship *Ares* and a volunteer flight crew are standing by, but the ship's regular pilot has been turned down by White Sands space surgeons. However, White Sands has contacted one of their experienced test pilots, Captain Dan Blaine. At last report, Captain Blaine had turned down an immediate take-off, as it is a pilot's privilege to do. Our latest attempt to contact Captain Blaine for a statement of his reasons has failed. In view of the opinions expressed by White Sands officials regarding the possibility of a take-off at this time, it can be assumed that—"

With a roar, Dan heaved an ash tray at the picture tube, but the voice of the announcer droned on. Disregarding the broken glass, he walked over and turned it off.

He stood there shaking. The tips of his fingers were tingling, and he could feel the flesh of his face grow tight and numb.

"What have you got to lose?" he asked himself out loud. "Are you a good pilot—or did you lose your guts back there somewhere? You can do it! Show them that you can! Show Dave and Jeanie and the whole stinking lot! Go, you fool!"

It took him an hour to get over the pass to the sands. The blowing dust obscured his vision so badly that he could not see the road at times. Atop the pass, he could see waves of sand being blown across the Tularosa Basin marking the lines of the gusts. The only casualty of the trip was a crumpled fender where his car had met with a roadside post during a blinding gust. And it looked as if he was going to have to have another paint job and some window glass; the car had been thoroughly sandblasted.

Pete Schneckle looked surprised when Dan walked into Operations. "Decided to do it after all, Dan?"

"Yeah. I tried to call back, but my phone was out."

"How do you feel? Hangover gone?" Pete asked.

"No. I feel lousy, but I can fly."

"I'll brief Med Check to toss some thiamine into you."

"Never mind," Dan replied curtly. "Where's my crew? I want to talk to them. And I want to go over the mass distribution sheets."

"Later," the Operations man told him. "The chief wants to see you. Come on."

Colonel Hardin, chief of the Space Personnel Division, was gazing morosely out the window at the dusty atmosphere. He turned as Pete and Dan came in. "Sit down, gentlemen," he said quickly, returning to his desk and snubbing out his cigar. He took a seat behind his desk and chucked a sheaf of papers into a tray. The colonel was a small, middle-aged man with a pair of rock-steady eyes and a calm, round face. Every movement he made was careful and precise. Dan knew he'd first come to White Sands in the early days when it was still a rocket proving ground; he'd fought for high-altitude rockets and space medicine; he'd helped establish White Sands as the only place with the facilities, the know-how, and the drive to fire the first of the orbital missiles; and he'd seen the barren stretch of desert grow into its uncontested place as the world's first spaceport.

"I'm glad we could get hold of you, Blaine," the colonel went on. "This is a last-ditch emergency—and you're the only pilot left who is capable of getting a ship up to the station. The weather's got us in a spot. Lifting a ship in this wind is going to call for some fast thinking; I know from your record you're capable of it. It's also going to call for good judgment.

"You're not lifting a test ship this time, captain. I know you're used to risking your own neck . . . but this time if it comes to a showdown—on the ground or in the air—you're going to have to make a different sort of decision than you've made when only your own life was at stake. Do I make myself clear, captain?"

"I think so, sir. I can handle that ship. I'll make it."

"I don't question your abilities, Blaine. I just want to make sure *you* know what this mission entails. It *must* be successful—regardless. If you fail, everything we've fought for in the last fifteen years will have been lost." He pushed back his chair.

Dan got up. "Will that be all, colonel?"

The colonel rose also. "Yes, except—" He thrust out his hand. "Good luck, Dan."

He had no trouble with Med Check; he never did. After putting on his flight gear, he reported back to Pete. "What's the latest word from upstairs?"

"Nothing, Dan. I told you their communications went out."

"Great! I hope the ship's radar can find them without their beacon."

"Your crew's waiting in the briefing room," Pete reminded him.

Dan knew them all. He'd seen their names on the schedule boards, out at the launching areas, and in the Space Crew's Club. Pete gave them the usual brief on weather, ionosphere conditions, orbit, and approach. Then he turned it over to Dan.

"I've never flown with all of you before," Dan began, "and I'm going to be relying quite heavily on you boys. I want action fast and on the bounce. I don't have the slightest doubt but that we'll make it; if anybody else does, he'd better stay on the ground."

"We wouldn't have volunteered otherwise, Dan," Bill Eaton, the regular co-pilot of the *Ares*, put in. "I think everybody here knows you're one of the best pilots around. We'll team with you."

"Good." He dusted a spot on the table and sat down on the edge. "How does it look, ship-wise?"

"Lousy," Frank Schultz, the radar man, told him. "The radar screens are full of snow and almost unreadable. The ship is picking up a terrific static charge from the sand blowing against it."

"Communications the same way," Ed Freeman put in.

"How about the power plant?"

"I've done my best to keep the sand out," Jake Morris replied. "I sealed the jet nozzles with diaphragms and purged all the lines with helium."

Dan nodded. "O.K. Operational plan looks this way to me: White Sands has all their radar dishes tied down so they won't blow away, and our own screens are cluttered. Bahama will be below horizon until it's

too late to use them for command. We'll forget about radar and communications. Bill, set the chronometer, and we'll lift on our own countdown."

Bill shook his head slowly. "We're in the soup without radar."

"Rig the autopilot for pre-set tape, gyro-stabilized, with provision for manual override," Dan ordered.

"Think you can override manually for gust compensation?"

"Sure. I'll fly her by the seat of my pants and the gyro selsyns," Dan said confidently. He could feel—almost see—that these men trusted him as far as ship handling went. They knew he was good. It was going to help; he was beginning to feel less cocksure, but he couldn't afford to show it. Looking at his watch, he went on, "Two hours to zero. Let's not waste any more time."

The concrete pad and the murky form of the *Ares* towering up into the dust made a weird, surrealistic picture as Dan got out of the jeep at the launching site. The sun shone only as a dull orange disk, and outlines were blurred and fogged everywhere.

Outside the protective closure of the jeep, the wind was like a massive hand. It ripped and tore at him, and the stinging sand forced him to shut his eyes and cover his face with his arms. Between gusts, he managed to stagger a few steps further across the pad. The collar of his coveralls beat a tattoo on his cheek, so he rolled it under. The sand was piled against every projection, and blew in weaving threads across the concrete. It was a struggle to breathe.

Scientific weather control was rendered absolutely powerless in the face of meteorological disturbances of the size which produced winds like that. Dan, and every rocket man, knew what caused them: recurrent deep spring low pressure areas sweeping across the continent as the warmer summer air masses tried to push up from the tropics. The tremendous cyclone was over Kansas and was displacing air all over Mexico and the southwestern United States. On the broad expanses of New Mexico were few barriers to offer ground friction to the wind. The anemometer had indicated a steady fifty-five-mile wind at Operations.

The loading tower was shivering and screaming. On the platform at lock level, Dan could feel the entire structure swaying. And the full realization of the terrible force of the wind suddenly dawned on him. A sick feeling welled up inside him, and he began to doubt himself.

He was a fool! He should have stayed in Las Cruces! This was sheer death, this thing he was going to do.

But Bill Eaton, Frank Schultz, and Ed Freeman were behind him. He walked through the lock.

Inside, things weren't any better. The wind moaned around the hull,

causing big skin sections to oil-can with booming reports. He could feel a slight sway to the deck.

Bill climbed into his couch and started strapping in. "Dan, I'm going to quit and take up cotton farming. Only weevils, drought, fire, flood, and acts of God to worry about."

"Worry about those gyros right now," Dan shot back. He settled his helmet comfortably, fastened his straps, and plugged in. "What's the minus-time?"

"Twelve minutes to zero."

"Right. Get out the cook book. Electrical check first, components next. Ready?"

"Ready."

He moved through the functional checks automatically. Things appeared as in a dream, and he felt distant and tingling all over. He shouldn't be

doing this! He knew he shouldn't! This was against every basic survival instinct! This was danger! This was death!

You're scared! he told himself. *You've faced danger before! Get into orbit, boy! This is no worse than a first-lift test!* Yet he knew it was.

"Two minutes to zero . . . Mark!" Bill announced.

He wasn't scared any more. Instinctively, he slipped into the groove. He didn't want to have to think now; he wanted to concentrate on his job. "All boards to FLY! *Stand by to lift ship!* All stations report!" he snapped.

"Co-pilot," Bill replied levelly. "All control circuits ready. Gyros tracking and autopilot tape feeding. Ready on first star fix."

"Power ready," Jake Morris' voice came through. "Booster squib lines hot! Power plant at pre-launch and tanks pressurizing! Cut-off circuit hot as of . . . *now!*" A red light winked on Dan's panel. "If she gives you trouble and you lose her, Dan, try to program her up-wind! I'll stand by to dump propellants!"

"I'm flying this ship! You twist her tail and don't dump or cut-off unless I tell you! I'll give the orders! Ed, how are conditions?"

"I can barely read White Sands Control."

"How about it, Frank?"

"Are you kidding? The screens look like a raging blizzard!"

"One minute to zero . . . Mark!" Bill cut in.

A gust of wind shivered the ship. For a moment, Dan thought she was going over. He felt and saw the control room sway and start to tip. But he suppressed those sensations from his inner ear; the gyro selsyns indicated the ship was still vertical.

"Thirty seconds!"

He suddenly realized how different this was from the test hops he was used to. People's lives depended on his decisions, and if something happened, he had to weigh all the factors and determine if it was worth it to abandon ship.

"Twenty . . . nineteen . . . eighteen —"

He had always laughed at his brother for being a glorified bus driver. Now he was beginning to see what it entailed. The tremendous responsibility resting on the shoulders of the scheduled pilots was something that scared him.

He began to see why they'd made him a test pilot.

"Ten . . . nine . . . eight —"

Over the sound of the wind, he heard the motor ignite.

"Five . . . four —"

The jet gave a mighty Bronx cheer as it hit transition between preliminary and main-stage burning. It smoothed into solid thunder as —

". . . Two . . . one . . . *lift!*"

The boosters fired, and he felt the

ship break ground. It started to lift like a ponderous silver whale.

At once it started to topple west, trying to weathercock like an arrow. The gyros sensed it, and the motor swung full against its stops on the gimbals. Manually, he cut in the ventral steering jet. It recovered slowly and started to fall the other way as the force of the wind dropped momentarily. He corrected his overcontrolling by firing the dorsal pitch jet. It swung again. He thought it was weathercocking; he could see the cabin tilt and feel a rolling motion. But the gyros said no.

Forget your instincts! he screamed at himself. Instincts were no good here. He *had* to rely on his instruments. He had no direct contact with the outside world and no other frame of reference to go by.

Gusts buffeted the *Ares* as it rose, and Dan fought to override the autopilot and compensate for the time-lag in its system. Battling the high-g, he found himself possessed of strength he never knew he had.

The ship was drifting downwind now, and picking up velocity and altitude with every second. Another gust tried to weathercock it. As Dan fought, it started to roll.

The *Ares* was trying to get aloft—trying hard; but it was going up like a fish swimming cross-current in a swift stream.

"Boosters away!" Bill sang out. Dan had wondered when they were going to separate; it had seemed like hours since lift, and he knew now it had been less than thirty seconds.

He felt a heavy concussion, and the ship went crazy. The dials on the gyro servos spun. He didn't have time to think; he reacted in old, established, unconscious patterns—patterns ingrained in him through test piloting. Had he been in a test ship, he would have ditched it immediately. Now he stuck to his guns, knowing he had to, knowing what would happen if he didn't.

He was only vaguely aware of Jake's voice rattling his headphones, "Booster Three fouled on separation! Hung up and carried away part of Fin Two! Got leaks back here!"

But the jetman's cut-off light did not wink. If Jake were really in bad trouble, Dan knew the jetman would not hesitate to cut-off to save an explosion or fire. "Stay with it!" he snapped. "I'm getting her back under control!"

The *Ares* had more stability now. Somehow, he fought it back to the point where he could let the autopilot begin programming it. He didn't know how he did it, and could not have explained; he was like a race driver fighting his car out of a skid on a bad corner.

So engrossed was he in his task that he missed Bill's announcement of "Stand by for cut-off!" It surprised him when it came. It was a normal autopilot cut-off. For countless aeons,

he'd been pinned to his couch; now he was falling. It snapped him out of it.

Bill's voice came to him, wildly enthusiastic. "*Beautiful!* Dan, that was one for the books, boy!"

Great waves of relief were washing over him. His breath came in gasping gulps; he had not realized he'd been so tense. He was cold and wet—soaking wet. "You ain't seen nothing yet, chum!" he snapped back. "Wait until we try to set this teakettle down without Fin Two! Get your first fix! I might have loused up the trajectory so bad on that lift that we'll miss intercept with the station! Jump!" He hit the intercom switch. "All hands secure from lifting! Frank, try to raise Bahama Beacon; get us a doppler radar check and shoot it to Bill! Jake, check your damage and report; make and mend if you can. We've gotten this far; we've *got* to make the station intercept! Ed, raise White Sands and tell them we made it this far! And warn them not to break out the drinks yet; we might miss the glory wagon as it goes by."

Dan hadn't missed it. With a slight correction, an hour later found them nosing their way through floating debris in the vicinity of the space station.

The wind had stopped, and the New Mexico atmosphere was beautifully transparent again as usual. Parking in front of Jeanie's house, Dan could see the Doña Ana Mountains rearing up to the north, their bare outlines as sharp as if they'd been drawn. The familiar Organs stood out boldly, angling up into the evening sunlight.

Jeanie opened the door almost immediately after he knocked. Seeing who it was, she backed away and motioned him inside. He took off his hat and stood inside the door, watching the girl.

"Dave is—?" she began.

"Dave is O.K.," Dan said quietly. "I just left the hospital at the Sands. He's all right. He's going to pull through."

Jeanie sat down on the sofa and ran her hands over her face. "I want to cry," she said, "but I can't."

Dropping his hat on the table, he relaxed into the chair he always sat in when he came over. "They snagged his capsule just in time. And we didn't think we were going to get him back to medical help. But . . . we did. That was the toughest job I ever had in my life."

She nodded, then looked up. "Would you like a drink, Dan?"

"I didn't intend to stay, but now that you've offered me one . . . yes."

Getting up he followed her into the kitchen. He dislodged the ice tray for her and reached the bottle on the top shelf when she couldn't. As she mixed the drinks, she asked without looking up, "You're not mad at me, are you?"

"Not now."

Jeanie gave him a glass, tossed the empty soda bottle through the wall into the trash, and picked up her own drink. "I want to apologize for that morning, Dan. I was upset."

"I know that now. Dave means a lot to you, doesn't he?"

She nodded. "Dan . . . even though Dave and I are getting married, I want you to know I still think a lot of you—" She held up her hand as Dan started to say something. "I would still think the same even if you had turned down the flight. It's just that . . . well, you and Dave are different; I don't need to tell you that. Dave is the kind of man I want to marry, that's all. You're—"

"I'm just your big kid brother."

"Well, not any more. You've changed a little since I saw you last." She was silent for a moment as she sipped her drink. "We still want you to be our best man, if you will."

"If I can, but chances are now that I'll be upstairs when Dave is down here. We're short of crews until the *Goddard* series takes over next month. I've still got to run the acceptance tests on the six ships of the class and help train the crews. And, between times, I'm on the schedule board, worse luck."

"You sound as if you don't like it. Isn't that what you've always wanted, the schedule board?" Jeanie asked.

Dan shook his head and took a swallow of his drink. "I thought I did. I had my crack at it; that's all I want. The regular runs just aren't my meat. I'm a test pilot, and a good one; I can't change. I don't want to change. Being a scheduled pilot is a different sort of thing, and Dave is the perfect pilot for the regular runs. Me, I'm *too* good, too fast, too hasty, too impulsive. I can make them fly; I can make *any* ship fly, or know the reason why. But once I know they can . . . well, I'm finished with them." He took another sip of his drink and went on, "No, Jeanie, the real space pilot is Dave."

"I've never heard you talk about Dave that way before," Jeanie observed. "You used to hate him."

"I guess I never really understood him. We had a long talk out at the station while we were waiting for the boys to cannibalize the *Apollo* so we could get the *Ares* back down. We didn't know whether Dave was going to live to see the ground again. You talk about a lot of things when you think there isn't very much time left to do it in." He glanced at his watch suddenly. "Speaking of time, I haven't got very much of the stuff right now myself. Got a training run in the centrifuge to make this evening, and a lift tomorrow morning. No rest for the weary." He drained his glass, walked to the living room, and picked up his hat. "You've got a good man, Jeanie. He's dependable. He'll never let you down. Me, I'll probably have a girl on every planet once we get

there—and we will. Thanks for the drink."

The evening paper was lying on the front porch where the newsboy had thrown it. The El Paso *Times*' headline glared up at him:

"STRANDED SATELLITE SPACEMEN SAVED BY HEROIC PILOT!"

It seemed funny to him that he didn't want to be called a hero. He felt that somehow he didn't rate the title. Or perhaps it was because he now understood what it meant: a hero is a guy who does a dirty job because he gets pushed into it.

The Organ Mountains were a ruddy orange in the light of the setting sun. As he watched, a lacy vapor trail advanced its finger toward the sky, and a brilliant star broke into the sunlight, climbing—climbing. He knew it was the reconditioned *Apollo* on its way out to the space station, the steppingstone to the planets.

Let them have the glory of conquering new worlds! He'd give them the ships to do it with: bigger, better, more powerful ships that would some day make Man the king of the Universe!

After all, wasn't he the best test pilot White Sands had?

THE END

IN TIMES TO COME

Next month's cover by Van Dongen is our first specifically Christmas cover — but decidedly suitable to Astounding. I invite you to name the expression on the face of the boy in that cover; it's a case where a picture is able to express something for which the language has no words!

The lead story, "Exile," by Everett B. Cole, presents the problem of a shipwrecked interstellar traveler who can build a transmitter that will call for rescue — but won't be rescued if he does! To build one, he'd have to enlist the natives of the planet; doing so is, for good reason, forbidden. How to get home, then . . . ?

THE EDITOR.

MOTHER OF INVENTION

It's long been held that Necessity is the mother of invention. But there has been no adequate discussion of the father of invention—Hard Work!

BY TOM GODWIN

Illustrated by Freas

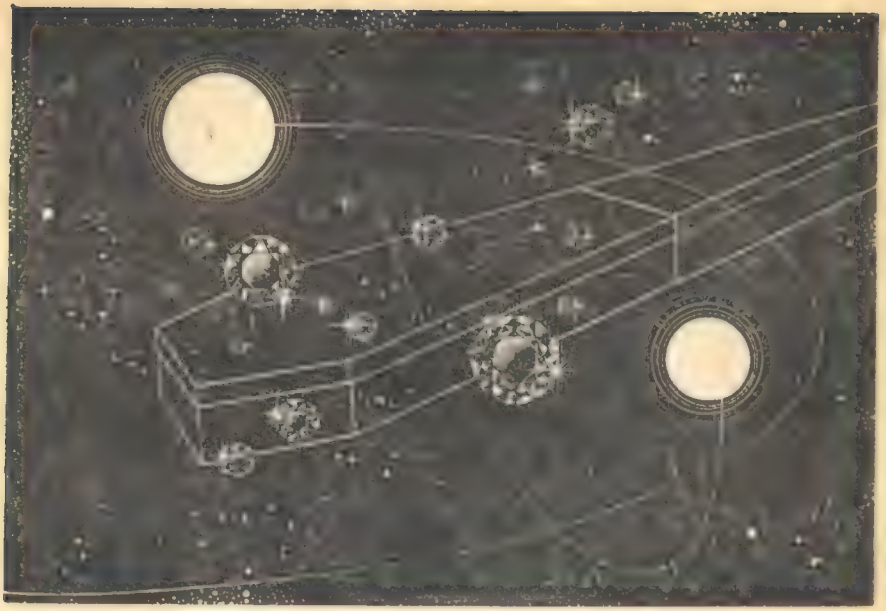
The human mind is adaptable and can condition itself to acknowledge the existence of any circumstance, even such an unpleasant circumstance as the certainty of death.

The human mind is stubborn, and while it will acknowledge the existence of unpleasant circumstances, it refuses to accept such circumstances as unalterable.

The human mind can be very ingenious at altering unpleasant circumstances.

(From "Variations Among Our Galactic Cultures," by the Antarean philosopher, B'Ral Gethan.)

It was hot in the drive room of the *Star Scout* and Jim Brannon, Ship's Drive Technician, was sick. It had started as another siege of his chronic indigestion, somewhat aggravated by the lecture his wife had given him that morning on his mental, physical and financial insignificance, greatly increased by an ill-chosen meal at the Spaceport's cafeteria, and now rapidly becoming a serious attack of acute indigestion. Of all the factors, the heat was the worst. The drive room portholes were open and a blower fan mounted in one of them was forcing great volumes of air through the room, but the air was being scooped from no more than ten feet above the scorched surface of Spaceport 1 and it was hot



and smothering with the humidity of tropical New Earth in midsummer.

He made a checkmark on the pad of ship's drive-inspection forms in his hand to show that the generator had been inspected and found to be in perfect operating condition, then returned the pad and pencil to his pocket before wiping the sweat off his forehead. The Bern nuclear converter was the last item in the drive room to be checked and he carried his box of tools and testing equipment over to it; a small, mousy man who usually moved with slow precision but hurrying now as he felt the first dizziness that was sometimes the forerunner of a faint spell.

The nuclear converter, which supplied both the fissionable fuel for the drive rockets and powered the ship's generator, was a fairly compact and self-contained unit of which only its fuel inlet required inspection. He extracted the special wrench from his tool box that unlatched the clamps on the fuel inlets metal cover and undid them. A thorough and methodical man who believed a good workman could be told by the care he gave his tools, he laid the clamp wrench back in its form-fitting recess in his tool box, rather than on the gritty floor.

He dropped the flat hinged clamps down against the sides of the inlet box and lifted off the metal cover, then

checked the metering devices that regulated the intake of the reel of tungsten thread. He hurried, as the feeling of faintness increased, to check the delicate device that controlled the intake of catalytic carbon. This done, he returned all his tools and instruments to their proper recesses in his tool box and withdrew the inspection forms from his pocket to check the last spaces on them. He returned pad and pencil to his pocket and picked up the fuel inlet's metal cover, setting it in place on its soft gasket that would render it air-tight when the clamps were secured.

The faintness increased as he reached out to lift up the clamps and he dropped back on his heels, trying to draw a deep breath and drive away the black dizziness. The dizziness increased and he had half-turned to shout for the other technician in the control room above when it swept over him in a black wave. He fell to the floor with his mouth wordlessly open.

A few minutes later the ship's elevator dropped to the drive room floor and the technician he had tried to call stepped out of it. "Hey, Jim, did you—"

The technician gawked a moment at the still figure on the floor, then ran over to him. A quick inspection showed Jim to be still alive and the technician hurried back to the elevator, dropping it to the boarding ramp.

"Call the ambulance," he yelled at a passing workman. "Jim's fainted again."

He waited until the ambulance arrived, then extracted Jim's pad of inspection forms from his pocket before they carried him away. The chief inspector appeared shortly afterward, his own master inspection form in his hand.

"Hello, Pete," he said. "I hear Jim fainted again."

"This makes the third time that's happened," Pete said, disgust in his voice. "It's his own fault—his wife's always nagging him to make more money so he puts in all the overtime he can, and between the overwork, the nagging, the heat and the sort of food they have at lunch at the cafeteria—and him being a puny little guy, anyway—it's no wonder his stomach rebels now and then."

"*My* stomach would rebel if I had the shrew he has for a wife," the inspector said. "Jim's a good sort—I like him, but that wife of his! Anyway"—the inspector mopped his florid and steaming face—"it's hot enough in this drive room to make *anybody* pass out."

"I still say a man's a fool to let a woman nag him into indigestion and even acute indigestion and try to work overtime when he's not able to," Pete, a bachelor, insisted.

"Well, maybe you're right," the married chief inspector admitted, "but he's the most reliable man I

have. He's slow, but when he marks down a ship's drive as having been inspected, you can be sure that he missed nothing. Which brings up . . . what did he lack in here when he fainted?"

"Nothing," Pete said. "Here's his inspection form—he has every item checked off. He had already put all his tools back in his box, too, so he must have been done."

The chief inspector took the inspection form and ran his eyes down it. "He has everything checked, all right. So, let's get out of this oven. The old tub is now ready for flight so far as Port Inspection is concerned, and they want to take off the minute we clear them."

"Where's it bound for?" Pete asked, pausing to light a cigarette.

"Out on the other side of the Thousand Suns cluster, somewhere. This is some little peanut outfit that call themselves Explorations, Limited."

"Oh?" Pete looked mildly interested. "The other side of the Thousand Suns has some unmapped systems, I understand. What are they looking for—did they say?"

"I wouldn't know." The chief inspector shrugged. "I only talked to them a few minutes. There are five of them—an elderly sort of a fellow, who threw up his job as dean of some little technological college in New Chicago, gathered up his three brightest graduate students and now they're all off into space to see the galaxy and seek their fortunes."

"You said there were five," Pete reminded him.

"There are. They bought this old heap—it was a service ship for the old Interplanetary Freightlines, once—and happened to run into a mining engineer just back from Charon. He had made a nice little pile in some iridium strike out there and he bought in with them. This had a rocket drive so the five of them managed to dig up enough money to have a hyperspace drive and that nuclear converter installed. I guess it took every last cent they had, too—those hyperspace drives and converters really come high."

"Well," Pete observed, glancing at the converter, "they sure wouldn't ever get anywhere with a rocket drive in normal space with the speed of light their maximum speed—not far enough away to mean anything in only one lifetime. It's pretty close to thirty thousand light-years to the Thousand Suns, isn't it?"

"Just about. Sixty thousand years for the round trip in normal space or a fraction over a year in hyperspace."

"But what a year! I took one trip in hyperspace when I was a lot younger and more foolish than I am now. Only a forty-day jump, but I never saw forty days go by so slow in my life. You have to accelerate to get anywhere, even in hyperspace, and between the constant acceleration and the blackness outside your ship you

feel like you weigh a ton and that you're stuck in a black tomb, not moving at all."

The chief inspector grinned. "Maybe you're subject to claustrophobia. And speaking of going somewhere—get Jim's tool box and let's get out of the Turkish bath."

Pete picked up the tool box and followed his chief to the elevator, not noticing that flat black clamps folded down against the flat, black sides of the fuel inlet box. It never occurred to him to give anything in the room a second glance; Jim Brannon was a methodical and thorough man and his inspection form showed that he had inspected everything in the room and found it to be in perfect condition.

The months passed for the *Star Scout* as she sped through the featureless blackness of hyperspace. At last the chronometers indicated that the time had come to commence deceleration and she made turn-over.

Down in her drive room the Bern nuclear converter squatted on the floor, a microscopic sun in its heart emulating the suns they were approaching by its conversion of matter into energy. The unclamped cover of the fuel inlet jiggled uncertainly during the first weightlessness of turnover, then lifted and floated to the ceiling as the drives made a corrective side-thrust. It remained there until the first thrust of deceleration came, then it was slammed to the floor with a loud clang.

The muffled thunder of the drives drowned the sound and none of the five men in the ship heard it.

The *Star Scout's* normal-space speed was far below that of light when she dropped out of hyperspace beyond the rim of the Thousand Suns. Two last stars lay beneath her; a binary composed of a small yellow sun and a larger blue-white sun. Observations were taken and instruments noted the tiny, shining mote that swung four hundred million miles out from the blue-white sun. Other instruments determined the new destination and the *Star Scout* vanished again into hyperspace.

When she dropped once more into normal space the shining mote had become a planet that blazed like a great, radiant gem against the black void beyond. The planet grew as the hours went by, filling the viewscreen as Blake braked for the descent into its atmosphere. Land masses and small oceans were faintly discernible through the fiery, opalescent haze that blanketed the planet. The image swelled and enlarged, the surplus running off the four sides of the screen, until the western side of a continent and a small portion of ocean filled the screen.

The four men in the deceleration chairs behind Blake, and held as helplessly as he by the force, watched the image on the viewscreen and the multiple hands of the air analyzer. The

hands began to move as the first thin sample of air was scooped into the analyzer, then settled into position a few minutes later.

"Breathable." The gray-haired Taylor spoke with difficulty against the deceleration.

"Less carbon dioxide than New Earth," Wilfred commented. Young, short and stocky, he was far less affected by the deceleration than the elderly ex-dean. "I can't understand why the spectroscope showed such an incredibly high percentage of carbon. How could any planet's crust contain such an excess of carbon?"

"The carbon *must* be in the crust, rather than in the atmosphere," Taylor said. "Either that or the old spectroscope is erroneous. We know the air analyzer is a new and reliable instrument, but these old Warden spectroscopes, like men, develop eccentricities with age. If we had a new—"

"Hang on," Blake interrupted, his eyes on the instruments before him. "I'm going to have to brake a little harder."

The increased deceleration settled them all deeper in their chairs and no one spoke while the section of continent on the viewscreen became a hazy desert or plain through which ran dim wrinkles. The surplus slid away and the wrinkle in the center of the screen became a range of mountains. Blake watched the transluscent white dot in the center of the screen that represented their point of landing and saw it would be along the eastern side of the mountain range. It would do as well as any other unknown section of the unknown world and he let the ship hold its course.

The green line of a tree-bordered creek appeared, hugging the mountain's foothills, with the white dot between the creek and the mountain. The area covered by the dot became a small delta of alluvium from one of the canyons with a few trees scattered across it. The delta swept up to meet them, slowing as it came, with the white dot in a flat clearing that seemed to be of some curiously glittering sand.

The *Star Scout* halted ten feet above the ground with a staccato of blasts from the drive tubes that sent the bright sand swirling in heavy clouds, then it dropped, cushioned by the drive, to touch the ground with a slight lurch. The wide tail fins settled in the sand and Blake cut off the drive.

"And here we are," he remarked.

The others were already hurrying to read the data recorded on the instruments; Taylor and Wilfred, Lenson and Cooke. Blake watched them, interested by their reactions. None of them had ever been off New Earth before, let alone on a world hitherto unknown to exist, and they were as excited as children with a new toy. Taylor, steeped in the academic en-

vironment all his life, was the most enthusiastic of them all. He had once told Blake: "With all due respect to ivied walls of stone, they can become a prison. I want to see a few things before I grow any older; deep space and distant suns and strange worlds—" Lenson, a tall, lean man with the easy grace of a cat, stood a full head taller than the pink young Wilfred; a pleasant sort of a man with a slow smile and a tolerant understanding of the foibles of others.

There was the indefinable mark of the intellectual upon all three of them and among them the paradox, Cooke, stood out like a black sheep among white. He was, Blake knew, fully as intelligent as any of the others; he, like the others, had been selected by Taylor because his intelligence and knowledge were considerably greater than the intelligence and knowledge of the average graduate. But he did not look the part. His dark, hard-jawed face was not that of an intellectual. Neither were his broken nose and glittering black eyes. Blake watched him, thinking: He doesn't belong with the others; he belongs on Old Earth three hundred years ago, on the deck of a pirate ship with a bloody cutlass in his hand.

But, for all his appearance of being a man of sanguine physical violence, Cooke seemed to be content to do no more than laugh at what his black eyes found in others and in life, itself.

"Earth-type in every important respect," Taylor was saying. "Gravity, temperature, air. No indications of any harmful bacteria—we've been incredibly fortunate."

"We had about one chance out of several thousand of this being an Earth-type planet, didn't we, Red?" Lenson asked, looking over at Blake.

Blake nodded his red head. "Quite a few thousand, since this isn't a class G sun. As Taylor said, we were incredibly lucky to hit the jackpot the very first try."

"Then let's get out and look our find over," Cooke said, shifting restlessly. "Let's get out and romp across the sand and breathe some air we haven't breathed a million times already."

Taylor looked questioningly at Blake and Blake nodded. "I don't see any reason why we shouldn't," he said. He checked the readings on the control board instruments from long habit and saw the red line that indicated the drive room's temperature. It was climbing rapidly, and he turned a knob marked: DRIVE ROOM—OUTSIDE VENTILATION. This would open the ports in the drive room and start the blower to rushing its great volumes of cool outside air through the overheated room. "Drive room's mighty hot from the decelerating," he said as he followed the others to the elevator. "If we had had a little more money left over, we could have had full-size coolers installed."

"We were lucky to scrape up enough money to buy what we have," Wilfred said, dropping the elevator to the cabin level.

"Our worries are over, now," Cooke declared. "Anyone who owns an Earth-type world isn't just rich—he's lord of all he surveys."

They stopped at the cabin level only long enough to procure a side-arm each. "You can't tell what you may run into on an alien planet," Blake said as he stepped back into the elevator. "No signs of any intelligent, civilized life, but there might be animals. Sometimes animals don't wait for you to run into them—they take a deep breath and do their level best to run into *you* and tramp you into the ground."

They dropped to the lower air lock and went through it. The boarding ramp was dropped to the ground and they descended into the cloud of dust that still swirled about the ship.

"The blower is filling the drive room with this dusty air," Blake said, sneezing. "I didn't realize it was so thick. But the drive room door is shut and none of this dust can get into the rest of the ship."

They walked out away from the ship and the dust and stood in the glittering sand, looking about them curiously. The mouth of the canyon was visible above them, with the iridescent haze hidding the higher peaks. The trees were almost like those of the desert regions of New Earth, scattered very thinly across the mountain's foot, and viciously thorned bushes grew among them. Some of them, Blake noticed, were in bloom with exotically beautiful blossoms, ranging from delicate pink to vivid scarlet.

"Pretty," Cooke commented. "A little dangerous to try to pick one, I'd say; those thorns are Nature's ice picks."

"We ought to name it . . . this world," Taylor said. "What shall we call it?"

"Aurora," Lenson said instantly. "She was the goddess of the dawn in ancient mythology. She was beautiful and she wore a veil. This world is beautiful and it wears a veil—that shining haze."

"A good name," Taylor agreed. He looked toward the creek a few hundred feet away, the creek itself hidden by the green trees that grew thickly along its banks. "Let's get a sample of the water for analysis."

They walked toward the creek, each of them unconsciously glancing back at the towering bulk of the ship as they went their way. Men always did that, Blake had noticed, when they set down on an alien planet. They would go out from their ship with their eyes alertly watching for danger ahead, and they never failed to look back at the ship as though to reassure themselves that it's ponderous mass was still there. It was a normal thing to do; when a man set down on an

alien world he was on his own and his only link with other humans and other worlds was his ship. It had brought him there; it, alone, could take him back. A man walked out from his ship knowing that it would be waiting for him to return, like a great, patient dog; waiting and ready to hurl itself into space at his command. Sometimes an alien planet held death for the bipeds who ventured to explore it, such as the spider-monsters of Nelson 14, and the ship would be the sword of vengeance for those who lived to fight their way back to it. The ship would avenge the fallen with fury in the thunder of its voice and annihilation in its flaming breath, leaving only drifting ashes where once had been alien things that had made the mistake of killing a human.

Without their ship, men on a hostile, alien world would be near-helpless; with their ship, they were invincible conquerors.

"Flowers, even," Cooke exclaimed as they neared the trees by the creek. "Red, blue, yellow, purple; green trees and good air—what more could we offer colonists?"

Blake had been examining the shining sand with increasing curiosity and he stopped to inspect a bright crystal half the size of his hand. It was not quartz. He scratched at it with his knife point but could not make any impression. The same would have been true of quartz, but the crystal did not have the appearance of quartz. It was alive with internal fires and the crystal system, such as he could tell from its rounded, worn form, was distinctly not that of quartz. A little way farther on he found one that glowed a deep ruby red. He paused to pick it up, then hurried on at an excited exclamation from Lenson, who had gone with the others to the edge of the creek. "*Look at this!*"

"This" was a crystal at the very edge of the creek's roiling, opalescent waters, the same deep ruby red as the one he had in his hand but a foot in diameter. Near it were other, smaller, crystals of blue-white, yellow, red, blue, green, with the blue-white ones predominating. The sand, gravel and rocks of the creek bed seemed to be composed exclusively of the bright mineral.

"Did you ever see so many quartz crystals in your life?" Lenson was asking the others. "Or so many different colors? Look at this one—it looks like a ruby."

Blake failed to hear the reply of the others, a thought he had had upon first examining the bright sand suddenly losing the fantastic quality which had caused him to dismiss it. It all checked, the lack of any mineral other than the one in the creek bed, the "erroneous" spectroscope that had shown the world to possess an impossible percentage of carbon, the high index of refraction possessed by

the mineral.

He could find out very quickly.

"Let me have your diamond ring," he said to Wilfred.

Wilfred pulled it off his finger and handed it to him with a look of questioning surprise. Blake scratched the diamond in the ring across the red crystal he still held in his hand. It left no impression and he repeated the performance on several other crystals scattered on the ground near him. On none of them could he produce the faintest scratch with the diamond in Wilfred's ring, no matter how heavily he bore down.

"The spectroscope was right," he said, wondering if the others would find it as hard to believe as he did. "I don't see how it could be, but it *is*."

"Is what?" Wilfred asked.

"Carbon—all these crystals are *diamonds!*"

They stared at him, incredulous. "They couldn't be!" Wilfred objected. Lenson asked, "How can you tell for certain? Are you sure?"

"The dimaond in this ring won't scratch them," he replied. "The only mineral a diamond can't scratch is another diamond."

"Then they really are diamonds?" Taylor said, dropping to his knees to pick up a deep, bright-blue one that lay beside the ruby-red stone that Lenson had found. "But the variations in color—are they *all* diamonds?"

"All those that are any size," Blake told him. "The softer silica would soon be reduced to a powder by the grinding action of the diamonds in the creek bed. Anything of any appreciable size that shines is pretty certain to be a diamond."

"Hm-m-m!" Cooke grunted, and shook his head in amazement. "I'm delighted to hear it, but it's still hard to believe. Talk about luck—here we sink our last cent to make this one trip, with the odds all in favor of our finding nothing, and the first thing we do is hit a double jackpot; not only an Earth-type—almost—planet but also an unlimited fortune in diamonds. Such luck is incredible."

"It *is* incredible," Blake agreed. "It just isn't the sort of thing that—"

His voice was drowned by a thunderous bellow from the ship. He whirled toward it, as did the others, wild disbelief on the faces of all of them. The same thought flashed in their minds in the same instant; *they were all five there—there was no one in the ship!*

The ship shot into view, leaping high enough in the air that they could see it above the trees that surrounded them. A gout of blue-white flame was lashing from a hole torn in its stern, then the flame vanished and the ship poised motionlessly for a moment; a great, metal monster halted in mid-flight and pinned against the background of hazy sky. Then the nose dropped, the tail went up, and it fell. It fell in a horizontal position, its

impact hidden from them by the trees but the sound of it loud and terrible to hear; the muffled scream of rending metal shrill above the ground-jarring thud of the impact.

Blake ran past the others, toward the ship. He was vaguely aware of someone yelling, "*What*—" then he broke through the concealing trees and stopped, appalled by the sight that met his eyes.

Spaceships were made to withstand the pull of gravity when at rest on their tail fins; to withstand the thrust of the drive which, whether accelerating or decelerating, was only the equivalent of gravitic attraction from the stern. They were constructed to possess great longitudinal strength, with no great cross-sectional strength needed. They were not constructed to withstand a horizontal drop.

The *Star Scout* was broken in two.

Taylor stopped beside him, white and shaken.

"What . . . what was it?" someone asked. "What happened . . . how *could* it happen?"

"The converter blew up," Blake said, his lips feeling oddly stiff and numb. "It was my fault—I should have had brains enough to think about it before it was too late."

"What do you mean?" Cooke demanded.

"I left the blower going, driving cool air into the drive room. The air was loaded with the dust we stirred up when we landed, and that dust was

mainly diamond dust."

"Oh!" Cooke's eyes were fixed on Blake. "So that was it. Diamond dust —carbon—*catalyst!*"

"But how?" Taylor asked. "How could the diamond dust have gotten into the converter?"

"I don't know." Blake shook his head. "Maybe the inspection crew forgot to put the cover back on the fuel inlet—maybe the clamps broke while we were en route. Anyway, it happened—somehow enough of the dust got into the fuel inlet to put the amount of catalyst past a critical percentage and the converter exploded. I shouldn't have started the blower until I first went in and made a check of the fuel inlet."

"Why?" Cooke asked. "Did you ever hear of anything like this ever happening before?"

"No."

"Could it have happened in the dust of New Earth—or the dust of any planet you were ever on?"

"No."

"Then why should you have checked? You had no reason to think the fuel inlet might be open, and neither did you discover this was diamond dust until about a minute before the explosion. You couldn't have done anything about it in only one minute."

"I suppose not," Blake agreed, "but I can't help feeling I should have been more careful. But that's all water under the bridge; here we are among our diamonds with no way of getting home—not for a long time at best, I'm afraid. So let's see just how long that may be, just how great the damage to the ship is."

"From here," Cooke observed as they walked toward the ship, "the situation looks hopeless. Our ship looks exactly like an overripe watermelon that's had a bad fall. It's not only broken in two, with a few girders holding the broken halves together, it's also sort of flattened now, rather than round like it once was."

"And gaping open at every seam," Wilfred added.

They passed the stern of the ship, where the rim of the ragged hole still glowed redly with half-molten metal, and Blake motioned toward the deep furrow blasted in the ground where the ship had stood. "The blast was directional," he said. "If it hadn't been, it would have destroyed the lower half of the ship."

"It didn't make such a big hole in the stern," Cooke remarked with a return of his characteristic optimism. "We could patch it."

"Of course," he added bleakly, "we'd only have half a ship to drive, and no converter to power our drive—if we have a drive left."

They entered the ship by the gap where it had broken apart, climbing through the bent and broken steel. The elevator shaft, now a horizontal passageway, was accessible by climb-

ing up the ragged, torn sheet metal and girders. Blake made a suggestion to the older Taylor before they climbed up into the elevator shaft.

"I'd like to look at the drive room and the repair shop. So, suppose Cooke and I do that while you and the others see what the damage is in the forward half of the ship?"

"Anything you say, Red," Taylor answered. "I have an idea we'll find nothing but wreckage either way."

"First, I'll get some lights for you," Blake said.

He climbed up into the elevator shaft and made his way to the supply level of the ship. The door to the room he entered opened with considerable difficulty and the scene inside, as revealed by his pocket lighter, was utter confusion and chaos. He found the locker that held the emergency lights under a mass of miscellaneous supplies, equipment and broken containers and took five lights from it.

He went back to the gap in the ship and tossed three of the lights to the others. They began to climb up into their own section of the ship and Cooke scrambled up to where he stood.

"How did it look where you were?" Cooke asked.

"Just a little untidy," he answered, leading the way to the drive room.

They forced the now-horizontal drive room door open and a gush of warm air struck them. The drive room was fairly well lighted by the hole the converter's explosion had produced and they appraised the damage, not caring to drop the ten feet to the new floor.

"That shapeless gob over there by the hole—that's all that remains of our converter," Blake said. "The explosion was directional, all right, and the converter was working at minimum output—if it had been up to as much as quarter output, it couldn't have remained directional and at a quarter output the entire ship would have vanished in a blaze of glory."

He flashed his light down into the shadowy corners of the room and found what he sought. "Look—see that square metal thing?" he asked. "That's the fuel inlet cover. Sure enough, it wasn't in place—they must have forgotten to tighten down the clamps."

"And we *paid* them to do that?" Cooke asked bitterly, flashing his own light over the cover.

Blaked moved his light slowly over the drive assembly. Originally equipped with the old Harding atomic drive, the transformation to the hyperspace drive had—for financial reasons—been confined to the installation of the space-shift units and the installation of the nuclear converter to supply the enormous energy required by the hyperspace units to wrench the ship from normal space into hyperspace. Although a modern

drive would have been preferred, their limited capital had forced them to compromise by leaving the atomic rocket drive intact and modifying its fuel chambers to accept the tailor-made fuel prepared for it by the converter.

"How does it look?" Cooke asked. "*I* can't see where the blast did any damage to it. Am I right?"

"I think you are—the directional blast missed it and its construction was rugged enough that the fall didn't affect it. This is more than I had dared hope for—we can alter those fuel chambers back to the way they were and we have a rocket drive again.

"If," he added, "we can find uranium."

"And then what? Won't we be a little bit old and feeble by the time we get home through normal space, thirty thousand years from now?"

"Well, I don't know of any outpost of civilization we can reach in less than two hundred years," Blake said, "which would be too far to do us any good. However, to get anywhere in hyperspace, we still have to have a drive, you know. We have to have a drive to get off this planet so we can get in hyperspace in the first place."

"Once we fix up our drive and get away from here—how do we get into hyperspace with no converter to power the space-shift units?" Cooke asked.

"That is *the* question, and I don't know the answer. But I was taking first things first. If we can find uranium—and we surely can—we can soon solve every problem but that one."

He passed his light over the squat generator that had served to supply the ship with electrical power before the installation of the converter. It hung by two of its mounting bolts from the vertical floor, but it seemed undamaged.

"There's our power—if we had some way to store it," he said. "If we could devise a perfect condenser of unlimited capacity, we could accumulate enough power to give the space-shift units the wallop that would jump us into hyperspace. Anyway, whatever we do, we're going to need that generator. We're going to need electrical power for operating the lathe—if it isn't smashed beyond repair—welding, perhaps even for refining metals with some sort of an electric furnace."

"How do we power the generator?" Cooke asked.

"That can be done," Blake said. "Provided we have a lathe to build what we want."

He turned away from the drive room without further explanation and Cooke followed him to the repair shop. As with all other rooms in the ship's new position, the door was horizontal, but the repair shop was smaller than the drive room and it was no more than a six-foot drop to the new floor. Blake saw, with a sense of vast relief,

that the lathe was still solidly bolted to the vertical floor. The other equipment was a jumbled mass on the floor and they poked into it curiously for a few minutes.

"Not much in the way of broken stuff here," Cooke said. "Steel tools seem to stand up pretty good when a ship does a belly-whopper. I hope the transmitter fared as well."

"That's something we're all hoping, but you're the first one to speak out loud about it," Blake said. "I don't see how it could have survived—a transmitter is big, heavy and fragile."

"Neither do I. I suppose that's why no one dared even say he hoped it wouldn't be smashed."

"Let's see about our truck," Blake said. "If the transmitter is smashed beyond repair, we'll have to try to find uranium and we'll stand little chance of prospecting these ranges on foot."

Again, luck had been with them. The little truck was unharmed but for a crumpled fender. Some of its bright red enamel had been knocked off by the fall of the diamond drill rods but the diamond drill, itself, seemed untouched.

"And that covers the important things in our end of the ship," Blake said. "Let's see what luck the others had."

Wilfred was just descending from the broken elevator shaft, carrying a load of food and cooking utensils. "We'll camp out for a while, it looks like," he said. "With the new floors knee deep in wreckage and the doors six feet to ten feet up on the walls, living in the ship would be just a little inconvenient."

"We'll have to cut a passageway along the bottom side of the ship's hull," Blake said. "We can dodge the girders and just cut through the old flooring.'

"How did it look up there?" Cooke asked. "What about the transmitter?"

"We won't send any S O S," Wilfred said flatly. "The transmitter tubes are smashed to fragments."

"I was afraid they would be," Blake said. "Do the others need help with their loads?"

"They could use some help, all right," Wilfred said, climbing down with his own.

They crossed the gap and met Lenson and Taylor in the elevator shaft, each with a burden of sleeping bags and various other things needed for a comfortable night outside. Blake and Cooke relieved them of part of their loads and the four of them carried their burdens to the clean, sandy spot near one of the trees where Wilfred had set up their "kitchen."

Blake dropped his load and spoke to Taylor. "So the transmitter is ruined?" he asked.

"The final power stage is," Taylor replied. "The driver stage took the fall pretty well and we could couple

that in, *except*—"

"Except what?"

"In normal space that would give us a range of around a billion miles—no more than halfway to our sun's yellow companion. Useless."

"Oh—so we don't even get the chance to use our little driver stage in hyperspace?"

"The space-shift signal transformers are complete wreckage. Any signal we sent, even if we had our final power stage intact, would take three lifetimes to reach the nearest outpost through normal space. We could send a signal through hyperspace, with our driver stage, for sixty thousand billion miles—but the hyperspace transformers are broken and smashed and we could never, with our resources, replace them. So that brings up the question—what now?"

"Our space-shift units in the drive room seem to be undamaged and it wouldn't be difficult to change the rocket fuel chambers again so that we can lift the ship with an uranium fuel," Blake answered. "And we do have to lift the ship to make the jump into hyperspace under any circumstances. If uranium is to be found, we'll only have the one big problem to solve—and it's really big—how to produce enough power to activate the space-shift units. If necessity forced us to, I have an idea we might even make another converter. Of course, our success would be an uncertain thing and it would require years of work as well as luck, but it would be better than just giving up—at least, we would be trying."

He glanced toward the nearby canyon mouth. "Uranium is the vital essential, no matter what we do. I'm going to take a little walk while Wilfred fixes something to eat—I want to see what the formations look like, and if they offer any encouragement."

"And then we'll talk over our plans after we eat," Taylor said. "A man takes a more optimistic view of his circumstances when his stomach is full, anyway."

Blake walked until he came to the first bank of rock and gravel, then examined what he found with considerable muttering. The formations represented by the rocks that had washed down out of the cayon were almost like those of any Earth-type planet, with one incredible exception; every rock, whether near-granite, near-rhyolite, near-andesite, whether high or low in silica content, contained almost the same high percentage of diamond crystal inclusions. In the coarse-grained rocks, such as the near-granites, the diamond crystals were as large as the end of his little finger, while the fine-grained near-rhyolites contained the diamonds as minute inclusions. But, whether the rock was fine- or coarse-grained, the diamond was present in all in approximately the same high percentage.

He had just come upon his first specimen of Aurora's animal life when he heard the distant call of Wilfred announcing dinner. He ignored the call for the moment, walking closer to the small, brown-furred animal. It was about the size of a squirrel, with a round, dark-eyed face and a fat little stomach that it scratched in an absent manner as it solemnly watched his approach. It let him reach within six inches of it before it scampered a few feet farther away from him, to stop and resume its solemn staring.

Wilfred called again and he turned back toward camp, the little animal staring after him as he went. Apparently they would have no ferocious carnivora to contend with on Aurora —the little animal had been without fear of him, or virtually so. It had not behaved in the manner of an animal accustomed to the law of "Run—or be eaten!"

Dishes were scrubbed with a generous amount of sand and a small amount of water after the meal was over, then Taylor began the discussion of their circumstances.

"Our simplest solution would have been to send out an S O S," he said. "We could have contacted a ship easily enough on the emergency band —possibly one no more than a day or so from here."

"A day or so by hyperspace—two hundred years or more in normal space," Cooke commented. "A man doesn't really realize how great galactic distances are until he gets stuck thirty thousand light-years from home, does he?"

Lenson sighed and gave the broken ship a dark look. "I'm already beginning to acquire an unpleasant comprehension of the true magnitude of galactic distances."

"It seems to me that we have only two alternatives," Blake said. "We have to get either our ship or an S O S into hyperspace. We have the power to send the S O S through hyperspace, but the space-shift transformer that would send our signal into hyperspace is broken. The space-shift units that would send our ship into hyperspace are undamaged—but we haven't the power they would have to have. Which do we want to try to do—build a nuclear converter and take our ship back, or make a space-shift transformer for the transmission of an S O S?"

"We would not only have to make the transformer that would send our signal into hyperspace, we'd also have to replace the broken power stage of the transmitter," Taylor said. "The driver stage, even in hyperspace, would have a range so limited that it wouldn't reach the nearest outpost. Unless a ship happened to wander within its range, its signals would never be picked up. And Space being the size it is, that might not occur within our lifetimes."

"You think it would be useless to

attempt to duplicate the space-shift signal transformer and the transmitter tubes?" Wilfred asked.

"I'm convinced that their duplication is beyond us," Taylor said. "They require special alloys as well as rare gases. They require delicate precision assembly; in fact, the machines that assemble them would require years of labor to build."

"We already have the means of putting our ship into hyperspace," Blake said. "All we need is the power. It seems to me we could more easily figure out a method of accumulating that power than we could build precision electronic equipment. After all, all we need is a tremendous store of energy to power our jump into hyperspace—a lot of energy for a short period. The drop back into normal space doesn't require but a fraction of that power."

"If there is no hope of sending an S O S, then we haven't any choice but to do that, have we?" Wilfred asked.

"I think we can safely say that the hope of sending an S O S is nil," Taylor said.

None of the others voiced any disagreement and Blake said:

"If we can find uranium, we won't have much trouble changing the fuel chambers to suit the fuel. We probably will have to spend more time making the ship—or the stern half of it—air-tight again than anything else. At any rate, the whole thing is hopeless unless we do rig up an atomic drive. We have to lift our ship into space to slip it into hyperspace and there's no use conjecturing on how we're going to take the second step until we know we can take the first step."

No one spoke for a few seconds, then Taylor said, "I suppose we agree on that, then. Now, the important thing is; can we find the uranium?" He looked at Blake. "How about it—what do you think of the possibilities?"

"I couldn't say," Blake answered. "I haven't seen any of this country, yet. I saw no evidence of metallic ores in the rocks washed down out of that canyon, but we could hardly expect to discover uranium that easily."

"What *did* you find?" Cooke asked.

"These rock formations are similar to Earth-type formations, and the silica content is about normal—if a person discounts the diamond present. The diamond is present in all formations, whether high or low in silica, usually as small to minute crystals. The larger crystals we saw must have come from pegmatitic formations."

"Which are—?" Cooke asked.

"Extremely coarse-grained bodies of rock. Minerals in pegmatitic form as unusually large crystals. On Charon we found a perfect quartz crystal that weighed a thousand pounds in a pegmatitic formation. Cummings—an old white-haired fellow who had

been born on Old Earth—said that crystals much larger than that had been found on Old Earth in the past.

"There's something else about pegmatites," he added. "Pitchblende is sometimes found in pegmatitic formations. So, it may possibly be that the uranium ore we find—if we find any—will be in the same formation that these diamond boulders come from."

"Another thing—" Taylor said, thoughtfully. "We'll have to have cadmium. Cadmium and uranium—if we can find the two ores and refine them, we can alter the drive."

"Which will take how long—just as a wild guess?" Lenson asked.

Taylor smiled. "That's like asking how high is up. But, just as an optimistic guess, I'd say from one to two years."

Wilfred nodded his head in agreement. "I'd say that was about right—not less than one and not more than two years. We're lucky in that we have a lathe and other tools to work with, a truck to use for prospecting and all the mining equipment we need to mine the ore after we find it."

"The first thing will be to fix up a place to live," Taylor said, pulling up his pants leg to rub a skinned and bruised knee. "Climbing in and out of those rooms as we did this afternoon is hard work, and painful."

"Red suggested cutting a passageway along the bottom of the hull—using the bottom of the hull as the floor," Wilfred said. "That shouldn't take long. We can rearrange everything to accommodate the new floor and we'll certainly have to take the lathe down off the wall and set it up again on the floor."

Their first Aurorian sunset stopped all talk of future operations a few minutes later. The sun was invisible behind some distant range, its last rays throwing lances of ruby, emerald and gold across the scintillating rainbow field that was the western sky. The lances shifted as they watched, widening and quivering with the splendor of their ever-changing colors until they rippled across the sky like the banners of some celestial fairyland.

Lenson was the first to speak, after the colors began to fade. "I never saw anything like that," he said, almost awe in his voice.

"Nor I," Cooke said, sprawling back against his sleeping bag. "That looks exactly the way my mother used to tell me heaven would look—before she decided I'd never go there, anyway."

"Probably caused by several different layers of air currents, traveling at different speeds and carrying varying amounts of dust and water vapor," Wilfred offered.

"Huh!" Cooke snorted. "Do you always have to be so pragmatic and practical?"

"Oh, it was impressive, I'll admit, but there was a simple, everyday reason for its beauty—the one I sug-

gested, likely. Beautiful sunsets on Earth-type planets are due to water vapor and impurities in the atmosphere."

"Then, so long as we're stuck here, let's be grateful that our atmosphere does contain these beautiful-sunset producting impurities," Lenson said.

Blake, his mind busy with thoughts of the many things they had to do in the weeks to come, only half heard Lenson's statement but he would recall it often in the years ahead of them and find a certain amusement in conjecturing upon how bitterly mocking it must be ringing in Lenson's mind.

The afterglow faded from the sky and the Thousand Suns revealed themselves; a field of bright points of light shining through the haze with sufficient brilliance to throw dim shadows along the ground.

"We'll have to make observations," Taylor remarked. "I'll start making daily observations of our sun and its companion. We know the days here are about twenty-four hours long, but we don't know whether its spring or summer—or possibly this world has no seasonal inclination of the poles."

"I think it's spring," Blake said. "The higher peaks we saw through the haze were covered with snow. Of course, that's not very conclusive evidence."

"Let's hope it's spring," Taylor said. "We know that our year is about six Earth-years in length and, with luck, we may be able to get away from here before winter comes."

There was a little more talk of their plans; then, one by one, they spread out their sleeping bags and crawled in. Blake, the last to retire, sat for a while watching the golden field the Thousand Suns made of the haze, reaching from the western horizon halfway to the zenith. To the east the sky was dead black, with no star to relieve it. There were none in that direction; not for a long, long way. Aurora had recently passed the farthest point from the Thousand Suns in her orbit; a straight line would pass from her to her sun, to close by the blue-white sun's yellow companion, then on into the Thousand Suns.

Blake remarked, just before he went to sleep, "You'll see what utter darkness is before morning—after the Thousand Suns go down and before the sun comes up."

It required fifteen days to get the ship even partly in condition for living. There was the passage to be cut, doors to be fitted to keep out the fine dust stirred up by the afternoon winds, the ship's water tank to be equipped with sediment filters, the tables and chairs to be unbolted from their incongruous positions on what had become the walls, the truck to be lowered out of the ship—an endless number of things to be done.

Blake and Cooke left on the morning of the sixteenth day, leaving the

other three to continue the work on and in the ship. They watched Blake and Cooke depart with a certain wistfulness and Cooke remarked, as they ground away through the sand, "I think all would have liked to go with us. They'll have nothing but hard work while we're out enjoying the fresh air and new scenery."

"You may change your mind about 'enjoying' it," Blake said. "Walking can be hard work when you do it all day."

"What's this truck for?" Cooke wanted to know.

"To haul our stuff. We won't use it any more than we have to—we can make new shoes by hand but we can't make a new truck."

"Do you think the diamond dust will be that bad?"

"I hope we find diamond dust and sand are the exceptions rather than the rule, but all evidence shows the diamond to be present everywhere. If so, we'll have to use the truck as little as possible—if we find the ores we want, then the truck will be indispensable for hauling them to the ship. Whatever we have to have for refining the ores will have to be at the ship—or we'll have to haul a good deal of material and equipment to the ore. Either way, we'll have to have this truck, so we'd better take care of it."

"I can see your point," Cooke agreed, "but I doubt that we'll wear it out very fast. After all, this thing was made to use in country where there was silica sand, and diamond is less than fifty per cent harder than silica."

"If you were correct in that surmise, I wouldn't be worried," Blake said.

"What do you mean—'if'?" Cooke demanded. "Quartz has a hardness of seven and diamond has a hardness of ten. That's less than fifty per cent harder, isn't it?"

Blake sighed. "The true and unpleasant facts are these: Diamond is said to have a hardness of ten because it's the only thing harder than corundum's nine. A mineralogist named Woodell, a long time ago and back on Old Earth, determined the true hardness of diamond in comparision with quartz's seven and corundum's nine. The actual hardness of diamond ranges from a fraction over thirty-six to a fraction over forty-two."

"Oh." Cooke was thoughtfully silent for a while. "Then we can count on this diamond sand and dust being six times harder than the sand and dust this truck was made to resist."

"Six times harder, and also tougher."

They lurched across a small gulch and onto a silty flat, winding to avoid the thorn bushes that were scattered across it. The morning air was still and the dust they raised followed them in a dense cloud, coating their faces and clothing an iridescent gray, gritting harshly wherever two parts

of metal moved together, such as the driving controls. They had traveled an hour, enclosed in the cloud of destructive dust, when Blake said, "I wonder—"

"You wonder what?" Cooke asked, his black eyes made blacker by the gray dust that covered his face.

"I wonder if this diamond dust hasn't got us behind an eight-ball—a big, shiny eight-ball named Aurora."

They worked their way along the southern foot of the mountain, toward the high plateau to the east where the creek might have its headwaters. They prospected the canyons one by one, both by carrying back samples of the bedrock gravels to the truck, to pan for particles of the heavy uranium and cadmium ores they sought, and by use of the Geiger counters they each carried. Cooke ran the gauntlet from his first feeling of carefree adventure to a condition of sore, aching legs and blistered hands. Their picks and shovels wore away with amazing rapidity, even from digging in the comparatively loose gravels of the canyon beds, and they found nothing.

They reached the eastern end of the range; a high, bleak plateau where the creek had its headwaters and where the nights were chilly with the breezes from the slowly melting snowbanks. There was nothing there but barren flow rocks and the inevitable diamond so they turned and worked their way back down the northern side of the range. Cooke's soft muscles

hardened and his habitual optimism returned, undaunted by the lack of heavy-metal concentrates in the samples they panned or by the Geiger counters that remained silent but for the intermittent clicking of the natural background count.

Twice they found veins of soft iron oxide and once they found a narrow vein of low-grade copper ore but the mountain seemed devoid of any uranium or of any lead-zinc ore that might contain the cadmium they needed.

Blake cared for the little truck with painstaking attention, doing everything possible to keep the diamond dust out of its moving parts. But no way could be devised to keep the dust out of such moving parts as the brake drums, the ball and socket of the front-wheel drive, the control-lever linkage, the winch they were forced to use so many times, and many other moving parts. The air filter caused him more worry than anything else. He knew a certain amount of the fine dust was getting past the filter and into the motor, and there was nothing he could do about it. It was a good filter, made to protect an engine against silica dust; any silica dust fine enough to get past the filter would be too fine to cause any damage before it was reduced to an impalpable powder. But the diamond dust it admitted was six times harder than silica, as well as tougher—the diamond dust would refuse to be reduced to a harmless, impalpable powder.

They rounded the west end of the range early on the thirtieth day and saw the green line of the creek a mile away. The truck labored noisily as Blake turned it up a gentle grade toward the mouth of a narrow canyon and he shifted into a lower gear.

"It's a good thing we're only five miles from camp," Cooke said. "You're about three gears lower than you would be if this truck was in the same condition it was in when we left camp thirty days ago."

"I'm afraid this will be its last trip —I've tried to baby it along and keep the dust out of it, but you just can't inclose a machine in a dust-proof wrapper."

They left the truck on the smooth alluvial fan just outside the canyon's narrow portal and began the by now repetitious process of prospecting the canyon. It was late in the afternoon when they found their first cadmium; a thin gray seam of metallic sulfide in a rock washed down from higher on the canyon's wall.

"The gray sulfide is lead and zinc," Blake said. "Those little yellowish-orange spots in it are cadmium sulfide."

Cooke shook his head. "The percentage of cadmium is so slight—and the lead and zinc is only a thin seam."

"It might have wider portions where it's in place," Blake said, looking up the steeply sloping canyon's side. "It

shouldn't be hard to find."

They located it in place an hour later, halfway up the canyon's side, but it was only a short, narrow seam. Blake tried unsuccessfully to dig into it with his prospector's pick, the point of which had long since been worn to a blunt stub. Cooke, pounding vainly at the tight-grained formation beside him, stopped to light a cigarette and wipe the sweat from his face.

"We have acids and glycerine," he said. "If we only had a few holes drilled in this rock, we could fill them with nitroglycerine."

"There's a chance in a thousand that it might get wider at a greater depth," Blake said, ceasing his own futile pounding. "But how do we drill holes in it?"

"The diamond drill—" Cooke began, then his voice trailed off.

"Exactly," Blake said, seeing what was suddenly in Cooke's mind. "How do we drill diamond-bearing rock with a diamond drill?"

"How did we intend to drill holes for mining when we started out thirty days ago? I won't argue about the diamond drill—I can't see how it could drill through diamond-bearing rock—but why didn't we think of all that before?"

"We didn't know for sure that all formations carried the same high percentage of diamond," Blake pointed out. "We hoped such wouldn't be the case, remember?"

"What a world to live on!" Cooke sighed. "Everything we try to do is foiled by diamonds. How can a superabundance of just one element manage to cause so much grief?"

"Well"—Blake shook his empty canteen and glanced to the west where the sun had disappeared behind the canyon wall—"we can't do any more here, now, so we might as well get on back to the truck and have something to eat before dark."

Cooke led the way to the bed of the canyon, his blythe spirits returned sufficiently for him to be whistling by the time they reached it. They were halfway to the canyon's portal when it became suddenly darker, as though a heavy cloud had covered the sun. It grew darker, although Blake's watch said the sun was not quite ready to set, and when they were almost to the portal's cliffs, where the canyon suddenly opened out upon the desert, he became aware of a low roar above the crunching of his footsteps in the diamond sand. It came from the desert beyond the portal; a sound like a distant waterfall.

Cooke, two hundred feet ahead of him, was still whistling cheerily and had obviously not heard it. Blake increased his pace and was almost up with him when Cooke stepped beyond the cliffs that still hid the desert from Blake.

Cooke stopped, then, a look of amazement on his face, staring in the direction of their truck and the desert beyond. Then he wheeled to shout

back at Blake, "*What is it?*"

Blake was beside him a few seconds later and he saw the source of the sound he had heard.

It was a mile away; a great, high black wall rushing toward them, its towering crest lost in the atmospheric haze. It was racing toward them at perhaps fifty miles an hour, roaring with a deep, sustained roar and the sheer front of it seething and boiling.

"What—?" Cooke began, but Blake cut him off with a terse, "Come on!" He ran toward the truck, estimating the distance they must cover before the black wall reached them. The truck was not far—but the wall was traveling at least fifty miles an hour.

"Is it—" Cooke began again, then gave up as a gust of wind whipped sand in his mouth and devoted his full attention to keeping up with the fleet Blake.

They reached the truck with the black wall looming almost upon them and jumped inside, slamming the doors. "Sandstorm," Blake said, as Cooke started to ask again. A harder gust of wind lashed at the truck, stinging their faces with sand. "Close your window," Blake said as he cranked up his own. "Those baby zephyrs are the advance guard. I think we're in for a real one."

The black wall struck a moment later with a thunderous roaring and screaming, smashing at the little truck with savage blows and enveloping them in darkness. Sand and gravel slashed against the windows with a sharp, dry hiss and, above the roar of the wind, Blake could hear a violent thumping as the wind found an empty and unfastened water can in the bed of the truck and slammed it back and forth. The pounding ceased abruptly and Blake had a mental vision of their water can going in kangaroo leaps across the mountainside.

". . . Long do you think?" Cooke shouted through the darkness.

"What?" Blake asked, shouting, himself, to be heard above the howl and roar of the storm.

"How long do you think this will last?"

"Don't know. Sometimes a sandstorm will last an hour, sometimes ten hours."

He felt inside the utility box under the dash and found a flashlight. Its beam had the appearance of a three-dimensional cone in the dust-filled air of the cab.

"How did that get in her so quick?" Cooke demanded.

"It comes in every little crack and crevice," Blake answered, flashing the light through the windshield. The light revealed the dust and sand flowing past them with incredible speed. There were bright gleams in the torrent of air and sand as larger pieces of diamond reflected the light for a microsecond and bits of dead vegetation were being carried along.

Blake shut off the light and made

himself as comfortable as possible in his half of the small cab. "You might as well try to make your mind a contented blank for an indefinite number of hours," he advised.

Cooke followed his advice, grumbling at the lack of leg room. He was asleep within fifteen minutes; a fact Blake confirmed by a quick flash of the light. Blake sighed enviously and composed himself for the hours of futile thinking and worrying that would be his own lot until sleep came. There was, in the genial Cooke's philosophy, a blythe unconcern for "Unborn Tomorrow and dead Yesterday." But, while he envied Cooke for his carefree attitude, he wondered if it would be of sufficient stability to survive the eventual recognition of a not-so-remote possibility—that all their efforts to leave their shining prison might prove to be futile.

The wind was shaking the truck and roaring with undiminished fury when he finally went to sleep, still worrying about the diamond dust that was being driven into every tiny crack about the truck wherever two parts of metal moved against each other. Silica, over a period of time, would ruin machinery. This was diamond, not silica; this had a hardness of forty-two, not seven—

He awoke at dawn, stiff and cramped, with Cooke's snoring loud in the silence that had replaced the storm. He jabbed an ungentle elbow into Cooke's ribs. "Wake up—the storm is over."

"Huh?" Cooke blinked and straightened with a moan. "My leg's been asleep so long it—Hey! What happened to our windows?"

"We now have frosted glass all around," Blake said, rolling down the opaque window on his own side. "Diamond sand is really tough on glass."

He stepped out of the truck into the calm morning air and looked at the damage. Cooke came around from the other side and stared open-mouthed at the bright, gleaming metal side of the truck where, before, there had been a thick coat of hard red enamel.

"It looks like we need a new paint job," he said at last. "And we'll have to knock a hole in the windshield to see how to drive to camp."

Blake lifted the motor cover and ran a finger through the blanket of diamond dust that covered every part of the motor. It was heaped on more thickly where there had been grease or oil to hold it.

"What do we do about that?" Cooke asked.

"Nothing. If we should try to wipe it off, it would cause it to work in deeper. We can only let it stay and hope the grease will keep most of it from getting any deeper into the moving parts."

"I wonder how they made out at camp?" Cooke asked as Blake lowered the motor cover.

"I was wondering the same thing.

We'd better let the canyons to be prospected between here and camp wait for the time being. They're all near enough to camp that we can walk out to look at them, anyway."

They removed the opaque windshield and got under way, the steering wheel and gearshift lever grating harshly. They saw something shining metallically a half mile farther on and it proved to be their errant water can; lodged beneath a thorn bush, stripped of its enamel and polished to a high luster.

Taylor and Lenson were waiting outside the ship when they drove up. The question and hope was plain to be seen on Lenson's face but there seemed an almost imperceptible anxiety tinging the questioning look on Taylor's face.

Blake shut off the motor and climbed out. "Nothing," he said. "Not a sign of uranium."

Lenson's face reflected a natural disappointment but Taylor seemed to have something on his mind more serious than simple disappointment. "Then there's no hope of finding uranium in this range?" he asked.

"There was no indication whatever that there is any such thing anywhere along the range," Blake answered. He looked toward the ship. "Where's Wilfred?"

"He left early to spend the day prospecting. We have the ship pretty well fixed up inside and there hasn't been much to do the past few days. Now—how about other minerals? Did you find anything at all?"

"A thin seam of lead-zinc ore that carries a small percentage of cadmium. But I don't think the diamond drill could ever drill through the rock it's in."

Lenson grinned sourly. "I know it can't," he said. "We no longer have a diamond drill. While you were gone I got to looking around and found a formation that carried zircons. Since we'll need zirconium, we all three agreed it would be a good idea to set up the drill, put down some holes and blast out some zirconium-bearing ore. We set the drill up yesterday morning. By mid-afternoon we had worn out six of our eight diamond bits and were down four inches. I came back to the ship late in the afternoon to get some more oil for the drill's motor —we've been using it and it was getting worn—and the storm hit before I could get back to the drill. I had left the drill running; its progress was so slow that it didn't need any attention. I got lost in the darkness of the storm and finally had to hole up behind an outcropping until morning. Then I saw where I was and went on to the drill. I found the sand blowing into it while it was running had ruined it. Not only the motor, but even the gears of the drill, itself."

"It was no loss, I'm afraid," Blake said. "All the formations Cooke and I saw carried the same high per-

centage of diamond."

"But suppose we should find some ore—how do we drill it without a drill?" Cooke asked. "That is, suppose we find some ore that isn't so hard and filled with diamonds as to make drilling impossible."

"In that case, we'd probably find we could fix up the old drill after all," Blake said. He turned to Lenson. "You said you had been using the drill's motor for something else—what was that?"

"Water pump," Lenson said. "It seemed like a foolish waste of effort and time to carry water to the ship's tanks in buckets so we took the little high-speed water pump that we had brought along for the very purpose of filling the ship's tanks, took the motor off the drill—we weren't using the drill then—stripped enough tubing out of the ship's air circulating system to reach to the creek and set up our pump." He grinned again. "It lasted long enough to fill one tank, then the bearings went out. We fixed it and a week later, when we used it again, the bearings went out again. Finally, the last time we used it, the impellers were half abraded away as well as the bearings and shafting cut out."

"And the motor was wearing out, too?"

Lenson nodded. "The bank was dry and sandy where we set the pump and breezes were always stirring up little clouds of dust. The motor was in pretty bad shape before it soaked through our thick skulls that the dust was pure diamond dust and not at all as harmless as it looked."

"So now you're back to carrying water in buckets?" Cooke observed. "And Red and I are going to be back to walking. This is a cruel world to anyone accustomed to mechanized assistance."

"About finding uranium—" Taylor said, the aura of worry still about him. "What would you suggest next?"

"We can hike across the desert to the nearest range and see what we can find," Blake said. "It will be slow, doing it all on foot, but we have a boundless supply of two things on this world—time and diamonds."

"No." Taylor shook his head. "Time is the very thing we *don't* have. I haven't said anything to Len or Wilfred about it yet. I wanted to wait until all five of us were here to talk over what we—"

"Hello." Wilfred's hail interrupted Taylor and he came hurrying toward them. "I saw your truck pull in so I turned around and came back. Any luck?"

"None," Blake said. "It just wasn't there to be found."

"What was this about not having time, and something you hadn't told us yet?" Lenson asked Taylor, his eyes on Taylor's face.

The others turned their attention to Taylor as he spoke.

"I've been making daily observa-

tions with the transit, as you know," he said. "I've observed the apparent motion of our sun, the yellow sun, and the Thousand Suns cluster. I found that this *is* spring—whether late or early I don't know—but that's of no importance. I thought, at first, the yellow sun was swinging in its orbit around our blue-white sun. You can see the yellow sun—like a very bright yellow star—in advance of our own sun each morning. According to my observations, the yellow sun is making an apparent advance of approximately one degree every five days in front of our own sun. This happens to be what its apparent advance should be as we swing out in our orbit, so I became suspicious and made other observations. I discovered we are approaching the Thousand Suns at a speed of one hundred miles a second."

"That's what you didn't tell us?" Lenson asked. "I don't understand—we'll either be long since gone from here, or long since dust, before our wandering binary reaches the nearest star of the Thousand Suns."

"I said the apparent advance of the yellow sun is accounted for by our own orbital movement," Taylor said. "There is no orbital movement of the yellow sun observable. This isn't a binary—the yellow sun is a member of the Thousand Suns."

"You mean—" Blake began.

"In approximately seven and a half months the two suns will collide."

"And our position in our orbit at that time?"

"We'll go into the yellow sun the radius of our orbit—four hundred million miles—in advance of the collision."

Tall Lenson barely changed expression and the surprise on Wilfred's face hardened into quick stubbornness, as though he had already decided he would refuse to accept such a fate. Cooke leaned one hip on the fender of the truck, his black eyes flickering over the others as he analyzed their reactions. But for once, Blake felt, Cooke was finding nothing to amuse him.

"You're sure your observations were accurate—that there's no hope we might have already swung past the yellow sun by then?" Blake asked.

"I've made my observations as accurate as possible, and checked for errors. Our sun is moving toward the yellow sun at a hundred miles a second and a distance of slightly more than one and a half billion miles now separates them. Our observation of these suns couldn't indicate that they were not a binary during the brief period we dropped into normal space—especially with our limited means for taking observations from the ship. It was natural for us to assume that two suns so close together were a binary. Only very precise observations during the short time we observed them could have revealed the truth and we had neither the proper

instruments for such observations nor any reason to think such observations were necessary."

"It wouldn't have changed our circumstances," Blake pointed out. "With seven or eight months of grace, we would have landed to see what the planet had to offer in the way of mineral wealth, anyway."

"That's true," Taylor said. "The result would have been the same. So here we are and we have, according to my most optimistic calculations, six months to fit our ship with a drive and get away from here as fast as we can."

"*Six months?*" Cooke demanded. "You said it would be seven and a half."

"We'll have to be a long way from here by then—Aurora carries an exceptionally high percentage of carbon and you know what happens when any nuclear conversion process absorbs an excess of carbon."

"Oh-oh—*nova!*"

"And they reach out a long, long way," Taylor said.

"The hyperspace units—the power for them—" Wilfred began.

"If we ever find a way to power them, it will have to be en route in space," Taylor said. "Or that's the safest course of action for us, I would say."

"I agree," Blake said. "If we can find ore pure enough, we might possibly be able to take off from here within six months. It would have to be exceptionally pure ore—it's improbable that we can find such ore but we don't know that it's impossible. The first thing we want to do is to start getting as far away from here as possible, and as fast as possible. Given pure enough ores, we can do that, I think."

"You said 'improbable but not impossible,'" Taylor said. "Just how improbable do you think it is?"

"If the other ranges are similar to this one, our chances are very poor. We can try; we can go out as two different parties to save time. Cooke has had experience in the hills, now, and could go with one of you to the range north of us while I went with the other to the range south of us. If there's nothing in the adjoining ranges, I would say there is no use looking farther."

"Why?" Lenson asked.

"Time. Time and distance. Any ore we found would have to be carried to the ship on our backs—the truck is worn out."

"Then let's start today," Cooke suggested. "Since our time is so short, we shouldn't waste an hour of it. Let's start right now."

Blake glanced at the early morning sun. "A good idea. We certainly won't have any days to waste. We'll take along about sixty days' supply of concentrated food tablets, plus spare shoe soles and, above all, canteens."

"The concentrated food tablets for two months—" Wilfred began doubt-

fully, but was interrupted.

"For roughage we can eat thorn berries," Blake told him. "Cooke and I tried them. They're tasteless, but they're completely harmless." He turned to Cooke. "You can take Wilfred across to the north range. It's nearer than the south range, and Lenson is better built for the hike across the desert to the south range than Wilfred is—it will be about three days on the water in our canteens to reach that south range."

"And if the south range has no creeks or springs in it—how will you come back across the desert without water?" Taylor asked.

"We won't," Blake said simply.

Cooke slid off the fender and looked at the truck, shaking his head. "If only we could have had this truck to use—"

Blake and Lenson reached the south range on the third day of tramping across the glittering diamond sand of the desert, their throats burned and dry and their canteens empty. They found water; a seepage of sickening alkali water, but it was water. They found a creek of sweet water the next day as they started up the range's northern front, tumbling down out of the mountains and disappearing beneath the sand at the mountain's foot. It was a high, rugged range and they

found other creeks and springs as they went. They reached its eastern end on the thirtieth day and turned down its southern face. They came to the last canyon on its southwest slope on the fiftieth day and knew they had failed. They had found an occasional vein of iron oxide and, once, a fairly soft vein of copper ore, but there had been no indications of uranium.

On the fifty-fourth day they reached the ship again, gaunt and ragged, with Blake's red whiskers flaming riotously and Lenson's brown beard giving him the look of a benign but destitute young religious father.

As though by prearranged plan, Cooke and Wilfred returned at the same time; Wilfred's pink face burned red by the sun, his blond whiskers sprouting raggedly, while Cooke wore a bushy black beard that, together with his glittering black eyes, gave him an even greater appearance of piratical fierceness.

Taylor was carrying two buckets of water to the ship when the four of them appeared. He set the buckets down and waited.

"No luck," Blake said as they drew near him.

"Same here," Cooke said. "That range we went to was as barren as this one."

"I've been continuing my observations," Taylor said. "Everything checks with my first ones, and now we're sixty days nearer the end. We'll have to start accomplishing something pretty quick."

"I know it," Cooke said, scratching at his black beard, the tattered sleeve of his shirt flapping in the wind, "But before we start any long talks on what we shall do next, let's have something to eat besides thorn berries and pills. And take a bath—I'm so covered with diamond dust that, in the nude, I'd glitter like a precious jewel."

Taylor picked up his buckets of water. "There's enough water for all of you to take showers," he said, "so long as you don't waste it. I've been busy with other things or I would have had more water carried to the ship."

"We'll have to have a pump," Blake said; relieving Taylor of one of the buckets. "There's no use spending time carrying water in buckets."

Lenson looked at him sharply to see if he were joking.

"Did you take a look at what that diamond silt in the water did to our pump?" he asked. "It ruined it, and it was made of the hardest alloy steel."

"We can't use any kind of pump that has moving parts of steel," Blake said. "No steel alloy ever made can resist diamond. And, since steel is our hardest man-made material, it's obvious we can't use any kind of a pump that has moving metal parts. So, we'll not try to fight the diamond with harder steel alloys—if we had them—we'll just overcome the abrasion problem by making a pump that has no moving parts."

"Oh?" Cooke stared at him. "A brilliant solution but for one thing—how do we move water without the mover doing any moving?"

"We let the water use its own velocity to force part of itself higher than the source—we make a hydraulic ram."

"Hm-m-m!" Taylor grunted in self-disgust. "I could have had one made long ago, in my spare time, but I never thought of such a simple solution. I kept thinking of some way to combat the diamond's abrasion, rather than how to avoid it completely."

"But a hydraulic ram does have moving parts," Wilfred objected. "The valves. Without the valves alternately opening and closing, the ram wouldn't work. How do you keep valves in it?"

"The valves are so simple—one floating valve and one flap valve—that all we have to do is spray the valves and valve seats with plastic rubber. The diamond can't harm rubber—the rubber is so soft that the diamond's hardness has no effect on it."

A shower and a full meal did much to improve the spirits of the four men, and a shave did even more to improve their appearance. Taylor brought up the subject of their next course of action and asked Blake for his opinion of the desirability of further prospecting for uranium. Blake answered the question with a suggestion.

"We'll have to rest a week, even though our time is so short," he said. "This time we'll have *two* deserts to cross, as well as the mountain between, and our past sixty-day diet of food tablets and thorn berries has all four of us in pretty weak condition. While we rest up I suggest we try to think of some alternative to the atomic drive. I won't argue if the rest of you want to continue looking for uranium, but I'm afraid it's hopeless. Without a truck or any other form of transportation, it would do us no good to find the ore. We're not going to be given the time to carry ore for great distances on our backs, across deserts and mountains. So, suppose for the next six days everyone makes a try at thinking up some plan other than the atomic drive?"

"The more plans, the better," Taylor said. "If we had a large enough selection to choose from, we could pick out one that would be sure-fire. But I can't see how we can find a quicker and simpler way to lift this ship than the way the very first ship on Old Earth was lifted—the atomic drive."

The others felt the same way; they seemed quite willing to consider any alternate plan but with no conception of any such plans. Blake made no mention of the idea in his own mind, certain that it held their only hope for survival but fearing its radical departure from conventional lines of thinking would cause them

to reject it, despite the magnitude of its possibilities.

They made the hydraulic ram the next day and laid a line of the ship's air tubing to a point sufficiently upstream along the noisy little creek to give the necessary pressure. Shortly before the sun went down they connected the last length of tubing to the ram, then returned to the ship to wait for the first flow of water into the ship's tank. It required some time for the tubing between the ram and the ship to fill with water but the water came at last; a steady little trickle.

"You know," Cooke remarked as he watched the tiny flow, "those ancients weren't exactly fools."

"At last, we've won one round in our battle with this diamond dust," Lenson said.

"I want all of you to keep in mind how we did it," Blake said. "We did it by using the natural forces at hand and by *not* trying to fight the abrasiveness of the diamond grit. Remember this, in any planning you do—*you can't fight diamond with metal!*"

"I think we're all aware of that by now," Taylor said.

"I hope so. Until we acknowledge that fact, we won't get anywhere."

No further mention was made of their problem in the succeeding days and Blake hoped that such silence was indicative of serious thinking on their part and not merely a fatalistic acceptance of the *status quo*.

On the sixth day following their return they gathered in the central room of the ship for each to present his plan, if any. Blake procured a few small items from the repair room and his own locker just before the discussion began.

Taylor made a quick summary of their predicament.

"There could have been only three possible ways of leaving this planet," he said. "The most certain would have been to send a message to New Earth, but that's impossible. We can't repair or duplicate the smashed transmitter tubes or hyperspace transformer. Their construction calls for very complex precision machinery as well as special alloys. We can't re-use the various alloys in the shattered tubes because exposure to the air has turned several of the more delicate alloys to dust.

"The second easiest method, and the most impossible, would be to simply wait and hope a ship comes along in time to save us. I know that we all reject *that*. That leaves only one way of leaving this world before it burns—to make a drive for our ship. And that boils down to the question: Shall we continue to search for uranium and cadmium or shall we devote our time and effort to some other method of lifting the ship than an atomic drive?"

"I've kept my mind a receptive blank for six days and not one single idea has come near it," Lenson said.

"I don't see where we have any choice —what else can we plan on with any hope at all other than an atomic drive?"

"Before we go on to new plans," Wilfred said, "suppose we let Blake give his opinion of the chances of finding uranium and cadmium in time to make a drive."

"We haven't found any evidence of any uranium in three full-grown mountain ranges," Blake said. "There's iron, and a small amount of copper, but no radioactive elements. I don't know whether it's true of all this continent, but the section we're on is almost wholly light elements.

"I am *not* in favor of further prospecting. Our time is very limited; anything we do will have to be done without delay. Further prospecting, on foot, would require time, lots of time. Possibly the ore we want is within fifty miles of us, but how do we find it in time, on foot? Even if we found it, and in a sufficiently pure state, how do we transport it back to the ship in time? We have no truck, you know; we have only our legs and backs. If we had the time—and if this world permitted us to use the truck—I would be in favor of continuing the prospecting until we *did* find the ores we needed. The truck would shorten days of travel into hours; it would haul needed supplies and equipment to the ore and haul the ore back. But we don't have a truck any more—and we don't have the time. In my own opinion, further prospecting is a waste of our short and precious time."

"There doesn't seem to be anyone who disagrees with you," Taylor said when the others remained silent. "You paint a dark picture, but there's no denying the truth of it."

"Do you have a plan?" Wilfred asked.

"I have. You've all been thinking along conventional lines, haven't you?"

"Such conventional lines of thinking produced the ship that brought us here," Wilfred pointed out.

"It did, but the same conventional type of thinking is never going to lift it up again. I have an unconventional idea, and a deceptively simple question. If you can answer my question, we'll know how to make a drive for our ship."

Blake extracted several items from his pocket: a short steel bar, a square of sheet aluminum, a piece of thin glass and a large darning needle on a long thread. He laid them down on the table before him and continued:

"I'm afraid that conventional thinking won't work on an unconventional world. We've all been tackling our problem as though we were marooned on a counterpart of New Earth, with New Earth's dust-free air and plentiful supply of minerals. We keep thinking of a rocket drive because a rocket drive was the simplest type of drive to build on a world of machinery and radioactive ores. We

have neither, here; we don't have Earth-type resources and equipment to fight a decidedly non-Earth type environment. On New Earth we would use machines—all human technological progress stemmed from that simple little thing, the wheel. Without wheels there would never have been machinery, without machinery there would never have been the atomic drive. You've all seen that we can't have wheels on *this* world. We can't have wheels, we can't have any kind of moving-parts machines on a world of diamond dust. Our own science is built on the wheel and if we don't develop a substitute science for it, we go up in smoke in seven or eight months."

Blake picked up the steel bar. "There is one force that no one has mentioned, and it's a force that all the diamond dust on this world could never faze because it has no moving parts—*field-type force.*"

He picked up the needle by its thread. "This is a common bar magnet," he said, letting the needle click against the end of it. "We all know that opposite poles attract, like poles repel. I pull the needle off the end of the magnet and the needle snaps back against it the moment I release it because its lower end has been magnetized with a polarity opposite to that of that end of the bar. If I switch ends with the bar magnet, the needle, instead of being attracted to it, will swing away out on the thread to stay away from it. I have a piece of sheet aluminum here—the magnetic repulsion goes right through it. The same with this piece of glass."

He laid the magnet and needle back down on the table. "You four have the technical training and knowledge—I'm only a fairly competent mining engineer. But my common sense tells me the reason we can't leave here is because a field-type force, gravity, holds us here. My common sense also tells me that there must be the same basic principles underlying all field-type forces; magnetism, induction, gravity. If two magnetized bodies can be made to repel each other, as well as to attract each other, is it impossible that two bodies held together by gravitational attraction could be made to repel each other?

"As I said, I think the same basic principles underly all field-type forces. If we can learn what that principle is, we can produce a drive that operates by antigravity. So, this is the question I wanted to ask you: *What caused the needle and magnet to behave as they did?*'

There was silence for a while as they considered Blake's proposal. Wilfred was the first to speak.

"It's a simple phenomenon," he said, "and known to any child."

"That's true," Blake agreed. "Any child knows what a magnet will do, but do any of you know any more about a magnet than the hypothetical child? You all know *what* a magnet

will do—do any of you know *why* it does it?"

"Magnetism has been vaguely described as a force, a tension in the ether, I think," Lenson said, somewhat uncertainly. "I know nothing of magnetic forces, myself, since they don't enter my own field of study, but Cooke probably knows them from A to Izzard."

"I know what a magnet will do—I don't really know why it does it," Cooke said. "Men have made use of magnetism and induction forces for centuries and the behavior of such forces is known in precise detail—but still no one knows just what these forces *are*. You can manipulate a force to your own advantage if you understand its behavior under various conditions, but if you understand exactly what that force is, you can manipulate it to your own advantage much more efficiently."

"I agree," Lenson said.

"There's another field-type force we use without fully understanding it—our hyperspace drive," Blake said. "Theoretically, it shouldn't require such an enormous surge of power to activate the space-shift units—but we have to use that enormous surge of power to get any results. We say we 'slip' or 'jump' into hyperspace. We don't. We don't 'slip' through that barrier—we smash our way through it with the full output of a nuclear converter. If we can learn what field-type forces are, I see no reason why we might not be able to so alter our hyperdrive that the ship's generator will supply more than enough power for it."

"A possibility," Cooke said.

Taylor nodded in agreement, then said, "But, while the idea has unlimited possibilities, we haven't the slightest assurance that we'll realize any of them in the short time we have."

"I know it," Blake said. "I know it's a long chance, since our time is so short. But it is a chance, and all the other plans would have been doomed to failure before we started."

"It's something of a challenge," Wilfred said. "The idea appeals to me. It's true that we actually know relatively little of field-type forces; our environment was such that our technical progress led to atomic study."

Blake looked the four men over, both surprised and relieved that they should accept his plan without argument; the only possible approach to the problem, he was convinced, that offered any hope. Taylor seemed to be the only one who had any doubts and Blake said to him, "What is your own opinion of my plan? Are you in favor of dropping all other plans and concentrating on the study of field-type forces?"

"My half-expressed doubts about accomplishing anything in the time we have weren't intended as an objection. It's a field of study of which

we know very little, and it's a difficult field to learn. But I'm in favor of it—it, at least, isn't dependent upon the use of moving machinery. We can study it under controlled conditions, here in the ship. In fact, I would like to suggest the study of induction fields as a starter—we can manipulate induction fields to suit ourselves, and under all kinds of conditions."

"In all of Man's history," Cooke said, "since the first savage wondered why a piece of natural lodestone would attract grains of magnetite, no one has been able to discover why. But, while we don't have much time, we have a very powerful incentive. And we do know a few things about magnetism. For example: all ferrous iron with a valence of two is magnetic. Ferric iron, with a valence of three, is not magnetic. Let's find out why—an atom of iron is an atom of iron and should be magnetic whether it's combined with oxygen or not."

"We'll need juice," Taylor said. "Plain, old-fashioned electricity."

"We can manage that," Blake said. "The ship's generator wasn't damaged, so we'll make the only kind of engine a world without oil, coal or radioactive ores would have permitted—a steam engine. We have water, plenty of trees for fuel, and we have a lathe. There's a spare primer-thrust tube that will make a perfect cylinder."

"How about the diamond dust in the water?" Taylor asked.

"Only clean steam will go to the cylinder, and the diamond dust won't affect the boiler as lime would. Besides, we have our water filters on the ship's tanks."

Wilfred picked up the needle and let it swing from the thread, holding the magnet under it. "If this magnet represented this planet, and its magnetism was the force of gravity, with this needle representing our ship, fitted with some gadget to make it antigravitic at the lower end as this needle is antimagnetic—"

He let the needle swing on the thread, bouncing away from the repulsion of the magnet, then swinging in again, to be stopped and driven away by the invisible force.

"The invisible barrier," he said. "What is it? It isn't matter—not as we know matter. We call it a force, but just exactly what is it that no material—glass, metal or anything else—can bar?"

"That's the question," Taylor said. "It's going to be a hard one to answer."

"It will," Cooke said, "but we know the answer is there if we can find it. The power we need to move this ship is all around us; we'll be looking for the secret of a power that we *know* exists."

"And if we continued to hunt for uranium, we'd be looking for something that all the evidence shows does *not* exist," Blake said.

Lenson shoved back his chair and

got to his feet. "Now that we know what we want to do, let's get busy," he said. "It will take all five of us quite a while to build that boiler and engine, so let's get started right now."

"I agree," Cooke said. "We're headed for an unpleasant end at a hundred miles a second—the Bird of Time has but a little way to fly—"

"And Lo!—the Bird is on the Wing!" Wilfred finished, a rare smile on his pugnacious young face as he shoved back his own chair.

The generator was lowered from its hanging position on the wall and fastened to a new-laid flooring of steel. A gear box was made from the gears of the ship's elevator and the portholes of the drive room were equipped with glassite windows; windows which were rendered sub-transluscent by the first sandstorm, but would still admit sufficient light for working. The boiler and engine construction progressed slowly, with the small lathe and the limited kinds of material available, but they worked steadily while the yellow star advanced farther and farther ahead of their own sun. It gleamed in the dawn sky a full hour in advance of the rising of their sun when they began the building of the engine. On the day they completed the engine it was dispelling the eastern blackness two hours before the blue-white sun brought the first touch of the rainbow dawn and almost three hours before the sun, itself, appeared.

Blake, Cooke and Lenson toasted the steam engine on the day they completed it and gave it a successful trial run; a modest toast of one small glass each, due to the limited amount of grain alcohol in the medicine locker. Taylor and Wilfred, who never drank, had already gone into the central room to begin the job of converting it into a laboratory.

"She's not pretty," Cooke said, indicating the shapeless boiler and engine with his empty glass, "but beauty is as beauty does. And she spun that generator like a top."

"She did," Lenson said. "As you said of the hydraulic ram—those old-timers weren't exactly fools."

"We have all the power we need whenever we happen to need it," Blake said. "Next, as soon as we get the central room converted, will be to put our ideas to the acid test."

"They say the acid test is always sour," Cooke said. "We'll have to make an exception of that rule. And have you noticed our big yellow star? It's over forty degrees in advance of our sun, now—gives the illusion of traveling away from our sun, except that it keeps getting brighter."

"We're already a fifth of the way to it," Blake said.

"The nova created when Aurora goes into the yellow sun should be spectacular," Cooke went on. "And then what happens when our big blue-white sun goes into the nova? Will it

produce a super-nova? No man has ever stood off and seen such a thing, you know."

"Neither will we if we don't get busy," Lenson said. "Time, tide and Aurora's rendezvous wait for no man —and here we stand with empty glasses in our hands when we should be working."

"You're right." Cooke said, turning to go. "Holding an *empty* glass is about the most useless thing a man ever did."

The central room of the ship was converted into a laboratory—or as near to a laboratory as their limited equipment would permit—and large glassite windows were fitted into holes cut in the hull; a much better form of illumination than the improvised oil lamps they had been using.

Ideas were presented in the days to come; some that were no more than the repetition of known experiments and some that were contrary to accepted theories of magnetic and gravitic principles. The latter were, at first, presented somewhat self-consciously and Blake and Cooke did their best to discourage such reluctance to depart from conventional thinking. As the days merged into scores of days the reluctance to present unorthodox theories vanished and they all five adopted the policy of accepting each new theory with, as Cooke put it: "The assumption that every theory, no matter how fantastic, is innocent of the crime of invalidity until proven guilty."

Each experiment was given a number, preceded by the letter X for "Experimental," and the data gained by the experiment filed away. Blake, whose mathematical computations as a mining engineer had never required more than trigonometric and logarithmic tables, became as proficient as the others in the use of the slide rule. His lack of advanced technical learning was, in a way, no disadvantage—he had nothing to unlearn. He absorbed all the data available concerning the actual, observed behavior of field-type forces and rejected the adoption of any preconceived theories of the causes for such behavior, keeping his mind open for the unbiased inspection of new concepts.

Thirty days passed and then another thirty, while the yellow star grew slowly brighter and widened the apparent distance between itself and their own sun—the apparent widening of the distance that was so belied by the yellow star's increasing brightness. The first enthusiasm of Cooke, Lenson and Wilfred gave way to a quietness and they worked longer hours. Taylor betrayed no particular emotion but he was up early and to bed late.

Summer solstice came and the sun ceased its apparent northward progress and began to creep to the south, almost imperceptibly at first. The desert winds came with greater frequency after solstice, hot and searing and

bringing their ever-present burden of sand and dust.

They had been on Aurora four months when Cooke, in a moment of grim humor, chalked a huge calendar on the wall of the laboratory. He made it thirty days wide and five rows deep. Each day that passed would be filled in with red chalk and the red squares would move across the calendar, row upon row, warning the five men who labored in the room of the shortness of their time.

Two lines of thirty days each were chalked a solid red when they found the first key to the secret that meant their lives.

X117 lay on the laboratory table, a complex assembly of coils and electronic apparatus, with a small blue-white diamond swinging in a tiny arc just within the focal point of the induction fields. The diamond hung on a long thread, attached to a delicate spring scale with a large dial.

Cooke glanced over the assembly, then raked his heavy hair back from his face and grinned at the others. "This," he said, "should be what we've been looking for."

"You've said that every time," Wilfred reminded him.

"Let's find out," Blake suggested, feeling his usual impatience to learn as soon as possible if their efforts had again been in vain. "We have full steam pressure and our engine is ready to spin the generator whenever you close the switch."

"That's what I say—let's get the suspense over with," Lenson said. He closed the switch that would open the steam engine's governors and the faint chuffing of it in the drive room became a fast pounding. The needle on the generator output gauge began to climb rapidly and all eyes were transferred to the dial of the spring scale.

"Twenty seconds," Cooke said, his attention alternating between the diamond and his watch. "It should have built up an effect by then. If it hasn't, it will look like another failure and I'll have to guess again on the success of the next one."

No one else spoke as they watched the diamond swing gently from the long thread. It was only a small one, not more than ten grains in weight; such a small and insignificant mass to resist all their efforts to move it.

"Ten seconds," Cooke intoned. "Eight—cross your fingers and say a little prayer—three—two—*now!*"

The diamond continued to swing in its tiny arc and the pointer on the scale remained motionless. No one moved nor took their eyes off the diamond, even when the smell of scorched insulation became noticeable.

"It's overloaded, now," Lenson said, but made no move to open the switch.

"Give it more," Blake ordered. "Give it the full output of the generator—let's be sure of it, and let it

burn if it wants to."

Lenson snapped another switch shut and the full output of the big generator surged through X117. A coil went out in a flash of blue fire and someone cried out incredulously.

In the brief instant before the coil disappeared the diamond moved—*up.*

"*It moved!*" Cooke exclaimed jubilantly. "We're going to have our drive!"

There was a minute of quite natural elation and confused babble of excited talk during which Blake remembered to open the switch again. The muted pounding of the steam engine died away and the babble resolved itself into coherent conversation.

"We're on the right track, at last," Blake said decisively.

"We've just done something all our science has never before accomplished," Wilfred said. "We've created a force of antigravity."

"We have a long way to go," Taylor said. "We've built up a force of antigravity that lifted a diamond weighing ten grains—and it took the full output of our ship's generator to do it. But we now have a proven result to go on; we have the beginning of an understanding of the basic principles."

"When we get it where we want it, I doubt that it will bear any resemblance to *this*," Blake said, indicating the assembly on the table with his hand. "This just happened to be the

easiest way to produce a little of the force we were looking for. Like, you might say, the easiest way to produce electricity is to stroke a cat. But you wouldn't try to supply electricity for a city by having a million men engaged in stroking a million cats."

"I have a theory," Cooke said. "Once we learn a little more about this force we created we can try something else — we'll try reversing the gravitic flow, rather than building up a counter-flow. I want to work on that theory and see what the rest of you think of it. Such a system should require almost no power since no force would be created, merely reversed."

"The perfect ship's drive would be a field-type drive," Wilfred said, "for more reasons than one. The reason I have in mind at the moment is this; there would be no limit to the speed of acceleration since the ship and its occupants would be enveloped in the driving force. It wouldn't, to the passengers, be like the rocket drive where they're actually pushed along by the seat of their pants."

Blake nodded. "I've been thinking of the same thing. I suppose we all have, because the only way we're going to escape that nova is to accelerate at an unheard-of velocity. We can do that when we perfect what we're working on; with our ship and ourselves enveloped in the driving force we can accelerate *immediately* to any speed, and with no sensation of accelerating at all."

"No more acceleration hammocks and anti-acceleration drugs," Cooke said. "No more long periods of reaching maximum acceleration, then other long periods of decelerating. We really have something—or will have when we're through." He looked over at Taylor. "How much time do we have? Did your latest observations give us as much as a day more?"

Taylor glanced at the calendar Cooke had chalked on the wall. "Your calendar still holds good—the last day you have on it will be our last day."

"Eighty-five days — that's not many," Lenson said.

"No, but we're going to make progress from now on," Blake said. "We have something to work on; we've opened a door that no one has ever opened before."

"And if there's another door behind the one we opened?" Lenson asked.

It was Cooke who answered, the finality of conviction in his voice. "Then we'll open that one, too."

Lenson's question proved to be not an idle one; there was a door behind the one they had opened. In the countergravity they had created lay the key to the second door, the reversal of gravity, but it eluded them as the days went by. They repeated X117 and variations of it until the experimental-data record bore the number, X135. Cooke's theory was examined and re-examined and no fallacy could

be found, neither could any other theory be constructed that would fit the facts they had discovered. They accepted Cooke's theory as valid, and no one questioned the possibility of reversing gravitic flows with a negligible amount of power.

All were convinced of ultimate success—if they could but have the time.

The days fled by while they tried and tried again. They worked longer hours, all of them thinner and the bulldog stubbornness on Wilfred's face becoming more pronounced. The yellow star crept farther ahead of their own sun, growing brighter as it went, and the red-chalked squares marched across the calendar. Their determination increased as their days of grace melted away; a determination expressed by a silent intensity of effort by all but Cooke, whose intensified efforts were accompanied by considerable cheerful speculations upon the many pleasures New Earth would have to offer them on their return.

Blake wondered if Cooke's faith in their eventual success was as firm as he insisted, or if it was only a psychological attempt to improve not only the morale of the others but also his own. The red squares had crept across two more rows and over halfway across a third when he got his answer.

It was on the morning following the failure of X144. They had worked far into the night to complete the assembly of it and it had been devoid of observable results. The others had gone to bed to get a few hours sleep before starting the construction of X145 but Blake had found sleep impossible. The failure of X144 exhausted every possibility but one; the one represented by the to-be-constructed X145. Theoretically, X145 would be successful—but some of the others had been theoretically certain of success until their trial had revealed hitherto unknown factors. After an hour of the futile wondering and conjecturing, Blake gave up the thought of sleep and put on his clothes.

He walked down to the creek, marveling again at the beauty of a world so harsh and barren. The yellow star, now bright enough to cast his shadow before him, was low in the west as he walked up the creek and the eastern sky was being touched with the first emerald glow that preceded the rainbow banners. When the sun came up it would bring another day of heat, and the dry, swirling winds would send the diamond dust along in low-flying clouds. But in the quiet of early dawn it was cool and pleasant along the creek with the trees bordering it making a leafy green corridor along which he walked into the emerald dawn while the fresh scent of green, living things was about him.

He saw the bulk of something red, lying in the sand beside a tree, and he went over to it. It was a small mound of blood-red diamonds, and he saw

that someone had selected them for their flawless perfection. He squatted beside them, leaning back against the tree trunk and lighting a cigarette as he wondered idly who had placed them there, and why.

He forgot them as he rested and watched the emerald of the eastern sky glow deeper in color and the first touch of iridescence come to it. Aurora, for all her grimness, was a beautiful world, and along the creek a man could almost imagine he was on New Earth but for the glory of the dawn and the glitter of the diamond sand. The leaves of the tree over him rustled softly, and among the fresh green smells there came the scent of the red flowers that grew along the water's edge; a scent that brought a brief, nostalgic memory of the old-fashioned briar roses in his mother's garden when he was a boy. She had brought the seeds from Old Earth when she was a girl and an Old Earth, she had told him, they grew wild.

It was hard to believe, as he sat beside the creek, that it and the sweet-scented flowers and the leaves rustling overhead were not things of some stable world where they would remain so for uncounted lifetimes to come; where only the slow, slow dying of the sun could at last bring the end.

Gravel crunched behind him and he turned to see Cooke. "Nice here, isn't it?" Cooke asked, sitting down near him.

Blake nodded, then said, "I thought you were in bed?"

"And I thought you were," Cooke replied. "What do you think of the quality of the diamonds there beside you?"

"You're the one who piled them here?" Blake asked, surprised. "How long has this been going on, and why?"

"Ever since I said we'd unlock that second door. We may have to leave here in a hurry, but we *are* going to leave here. I just did the logical thing of using some of my spare minutes to pile up some of the choicest diamonds where we can get them in short order."

"Do you really believe that, or is this diamond-gathering just to bolster your confidence?" Blake asked, watching him curiously.

"What do you think?" Cooke countered.

Blake studied him, the hard jaw and broken nose, the glittering black eyes, and saw that they were not deceptive, after all. Under ordinary circumstances Cooke was easy-going and genial, but now the mask of good humor had fallen away for the moment and the hard steel core of the man was revealed. Cooke, like the bulldog Wilfred, would be stubbornly defying their fate when Aurora went into the yellow sun.

Yet, though such stubborn faith might prove to be in vain, it had its advantages. Stubborn men die hard—

sometimes it takes more than merely impossible difficulties to persuade a stubborn man to die at all.

"I think you have the right idea," Blake said.

There was a silence as Blake returned his attention to the dawn, then Cooke remarked, "We won't have but a few more like that—before we leave here, one sun or the other will be in view all the time. And, by then, the yellow one will be too bright to permit any sunrise effects from the other one."

"Aurora doesn't have many days left."

"What a show that will be!" Cooke mused. "First a nova as Aurora goes into the yellow sun, then the big blue-white sun will go into the nova." Then he sighed and said, "But I sort of hate to see it. I don't care about the suns, but I hate to see Aurora go up in a blaze, no matter how glorious that blaze may be. She's a hard world on humans, but she forced us to pull ourselves up by our own bootstraps. She's a beautiful little devil and I hate to see her be destroyed."

The good die young, Blake thought, watching the dawn flame into vivid, fiery life. Not that Aurora was good. She was cruel and beautiful; she was a splendid, glittering prison taking them with her on her swift, silent flight to extinction.

It was not the way a world should die. The death of a world should come only when the fires of her sun went out. A world should grow old and cold for millennia upon millennia; death should come slowly and quietly like that of an old, old woman. But it would not be so for Aurora; for her death would be quick and violent and she would explode a yellow sun into a nova as she died.

Two days later they were ready to put X145 to the test. It was similar to the long-past X117 in that the same blue-white diamond swung from the same long thread, but the assembly was of a different form and the steam engine was cold. They had made a battery, a simple storage battery, and X145 would either succeed or fail with the battery's small current.

The tension was far greater than it had ever been at any previous test, and even Cooke had no cheerful smile or remarks. X145 would be *the* test; if it failed all their labors leading up to it had been to a dead-end. And they would have no time to try another approach.

"I guess we're ready," Cooke said. Blake went to the rheostat that controlled the amount of current and the others grouped about the X145 assembly.

"I'll give it the juice gradually," Blake said. "Although if it as much as quivers at full current, we really will have our drive."

Blake watched the diamond as he turned the rheostat's knob. He felt the faint click of it as it made first

contact, then flinched involuntarily as something cracked like a pistol shot and the diamond, thread and scale vanished. Something clattered to the floor across the room and Lenson's surprised question was cut off by a shout from Cooke: "Look—the scale!"

He ran to where it had fallen and picked it up, holding it for all to see. There was a hole torn through it.

"How much . . . how much power did you give it?" he demanded of Blake.

"Minimum current," Blake replied.

"Minimum current," Wilfred murmured. "Minimum current—*and it shot the diamond through the scale!*"

The torn scale was passed from hand to hand and the talk it engendered was both voluble and optimistic.

Cooke hurried out after another scale and Blake and Lenson connected another rheostat in series with the first, then added still another when Wilfred gave the results of his calculations on the slide rule.

Cooke returned with the scale, a much larger one, and a block of copper. "Three?" He lifted his eyebrows toward the three rheostats. "If we can budge a pound of copper with full current through three rheostats, then we can lift a thousand ships with our generator."

The copper block was suspended from the scale, to swing down in the field of the X145, and Blake said, "I'll try minimum current again, even though it may not be enough to affect it at all. We can't expect it to do anything spectacular at minimum current, I'm sure."

He turned the rheostat knob a fraction of an inch and felt the faint click, his eyes on the copper block. There was a roar, sharp and deafening in the room, and the copper block vanished as the diamond had. A hard puff of hot air struck him and something ricocheted back down from the roof to strike him painfully on the shoulder, a fragment of metal from the scale. Wilfred was pointing upward, yelling something. ". . . *Through the roof!*"

Blake looked up and saw what he meant; there was a small hole torn through the hull of the ship over their heads, a hole such as would be made by a one-pound block of copper.

"*Three rheostats*," Cooke exclaimed. "We not only have the power to lift our ship; we could lift ten thousand of them!"

Cooke began to make rapid calculations on his slide rule and Wilfred followed suit. Blake, curious though he was, saw no reason for three of them to work simultaneously on the same problem so he waited, as did Taylor and Lenson. Taylor was smiling; the first time in many days he had seen the old man smile.

"The problem of power for the hyperspace drive no longer exists," Lenson said. "We can apply the same

principles to its alteration that we just now made use of and we can actually 'slip' through the barrier rather than bulldozing our way through it."

"We have a means of driving our ship and we have a means of slipping her into hyperspace," Blake said. "We've come mighty near to succeeding in our plans—will we have the time to succeed all the way?"

"Time?" Lenson looked surprised. "How much time do you want? We have seven days. Isn't that enough?"

Blake shook his head. "We can't have the ship ready in that short space of time. To leave here within seven days we'll have to—"

"Did I say ten thousand ships?" Cooke slapped his slide rule back together, his black eyes glittering with exultation. "We could move a world with the power in that generator!"

"We've really reversed the gravitic flow," Wilfred said, as enthused as Cooke. "The only power required to move an object is that for the reversing field—or whatever we should call it. This power requirement is negligible with a capital N."

"Homeward bound!" Cooke said. "Safe and snug beyond the nova's reach in hyperspace!"

"If we want to give up the habit of breathing," Blake pointed out.

The four of them stared at him, and one by one their faces fell as they realized what he referred to; the thing they had forgotten in the intensity of their efforts to devise a drive.

"The ship—" Cooke was the first to express the thought in the minds of all of them. "It leaks like a sieve!"

"How, in seven days, can we finish cutting the two halves of the ship apart, wall in the cut-off end and repair all the broken-apart seams?" Blake asked.

"We can't," Taylor said. He sat down, suddenly old and tired, his former cheerfulness gone. "I don't see how we could make the ship leak-proof in less than four months with the tools and materials we have." He smiled again, but without mirth. "But we came close to succeeding, didn't we?"

"We'll succeed," Blake said. "It's a tough problem, apparently, but I have an idea."

"How about inclosing the ship in a gravitic field large enough to hold its air by plain gravity?" Wilfred asked.

"And how big a field would that have to be?" Lenson asked.

"Big," Blake said. "Even in hyperspace, it will take us six months to get home—or near that. Air has a tendency to leak away and dissipate into space rather easily. I doubt that we could inclose the ship in a field large enough to hold enough air to last us for six months—as I say, it leaks away into space very easily."

"The gradual loss of our air would be an unpleasant way to die," Cooke said. "The ship leaks, we don't have the time to repair it, so what do we do? How do we solve that last little problem?"

"Seven days to do a four months' repair job—" Lenson sat down beside Taylor and sighed. "It looks like we *can't* make our ship leak-proof in the time we have. But surely there is *some* way—"

"There is," Blake said. "We have a perfect method of both getting home and keeping air in our ship. It should be obvious to all of you."

Questioning looks gave way to dawning comprehension. There was a long silence as they considered the plan, then Cooke said, "After all, a fortune was what we set out for."

"We'll have to call them in advance," Wilfred said. "We can't just barge in."

Blake nodded. "Homeward bound, safe and snug in hyperspace—but, as you say, we'll have to radio them in advance. If we just barreled in without giving them the chance to tell us where to park, it could raise merry hell with everything."

Bob Redmond, control-tower radio operator of Spaceport 1, New Earth, was puzzled. He scratched his thinning hair and leaned closer to the speaker. The voice from it came in distinctly, but faintly.

"Can't you step up your volume?" he asked.

"No," the tiny voice answered. "I told you we had to couple in the driver stage—our power stage is gone."

"How far out are you?" Redmond asked.

"About a billion miles. Did you get what I told you? This is the *Star Scout* and we're just back from beyond the Thousand Suns. We were going to get caught by a nova—"

"I got everything," Redmond interrupted. "Your planet was going into the yellow sun and its high carbon content would create a nova. You learned how to control field-type forces so that you would have a drive for your ship. So you came back to New Earth—or a billion miles out from it. But why do you keep insisting that I have my superiors engage an astrophysicist to tell you where to park your ship? And another thing—you said it would take four months to make your ship leak-proof and you only had seven days. How did you do a four months' job in seven days?"

"We didn't," the thin voice from the speaker answered. "That's what I'm trying to tell you and that's why we'll have to have an astrophysicist define our parking place. We didn't have time to repair our ship, and we couldn't inclose it in a gravitic field large enough to hold air for six months."

Redmond clutched his thinning hair again, feeling suddenly dizzy. "You don't mean—"

"Yeah. We brought the planet with us."

THE END

THE MICROPSYCHIATRIC APPLICATIONS OF THIOTIMOLINE

BY ISAAC ASIMOV

Asimov's original double-talk item on thiotimoline started Astounding's "Special Feature" series. This item was originally delivered as an entertainment item to a chemical club.

Some years ago, the unusual endochronic properties of purified thiotimoline were first reported in this journal (1). Despite the fascinating theoretical implications of these properties, thiotimoline research has languished, due largely to the distressing skepticism with which the first reports were met. This laboratory, however, due to the grants-in-aid made available to us by the American Association for the Advancement of Quantitative Psychiatry, has successfully extended its earlier observations in directions which were as unanticipated as they have proven fruitful.

It is the purpose of this present paper, in part, to show that by use of thiotimoline, certain mental disorders can be quantitated and their diagnosis converted from an uncertain art to an exact science.

The Endochronic Carbon Atom: As explained in detail in the previous paper on this subject, the unique property of thiotimoline is its extremely rapid rate of solution in distilled water. So rapid is this rate, indeed, that it dissolves 1.12 seconds *before* water is added. This endochronicity or "negative solution time" is truly unique, as far as we know. Barosjek and Libnicz (2) report small

endochronic effects in certain thiotimoline derivatives but we have been unable to confirm their findings.

Many speculations have been advanced in the past five years to account for this most unusual property of thiotimoline, some of the theories presented containing a levity ill-suited to the gravity of the problem. It is needless to add that most of the hypotheses placed in print have lacked any sound scientific basis and it is, therefore, not surprising that some of them have appeared in rather unusual places, such as in periodicals devoted to the dissemination of what is known as "science fiction."

Actually, there is nothing involved that passes the realm of sober science. Endochronicity must, of necessity, be an inevitable consequence of the molecular structure of thiotimoline, and as a first assumption, one may lay the responsibility at the door of the versatile carbon atom. This is not the first time that an advance in our understanding of the carbon atom has led to a major advance in chemistry.

In the nineteenth century, it was pointed out that the four valence bonds of carbon were *not* distributed toward the points of a square—as, for convenience's sake, they still are on the blackboard and on the pages of textbooks—but toward the four vertices of a tetrahedron (see Figure 1). The difference is that in the first case, all four bonds are distributed in a single plane, while in the second, the bonds are divided, two and two, among two mutually perpendicular planes. The second view has made possible an explanation of phenomena such as optical isomerism which had been impossible to understand in the light of the older "planar carbon atom."

Now once more we can broaden our scope. We can pass from the "tetrahedral carbon atom" to the "endochronic carbon atom" in which the two planes of carbon valence bonds are not both spatial in the ordinary sense. One, instead, is temporal. It extends in time, that is. One bond extends toward yesterday and one toward tomorrow. Such a carbon atom cannot be presented on paper in the ordinary way and no effort will be made to do so.

Such an endochronic carbon atom is obviously very unstable and can

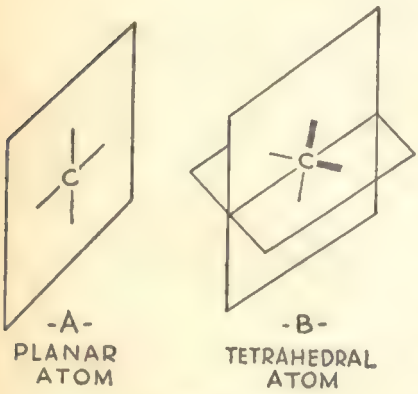


Figure 1

occur only rarely, in fact only within the molecule of thiotimoline as far as we know. What there is in thiotimoline structure to cause this, what sort of super steric hindrance is as yet unknown, but the endochronic atom undoubtedly exists. As a result of its existence, a small portion of the thiotimoline molecule exists in the past and another small portion in the future.

It is this small portion of the molecule existing in the future which is dissolved by water which also exists in the future—i. e. is about to be added to the thiotimoline but has not yet been added. The remainder of the molecule is dragged into solution in the process and thus "dissolves" in water which to all appearances is not there. Once this is understood, the mystery and apparent paradox disappears from thiotimoline's behavior and the whole becomes something quite prosaic and amenable to mathematical analysis.

Such a mathematical analysis is now in preparation and will be submitted for publication at a future date. In connection with that, it may be stated briefly at the present time that the possession of endochronic properties necessitates the possession of exochronic properties as well. Considerable effort is being expended at our laboratories now to detect such exochronic properties. If, for instance, a small sample of thiotimoline solution at an original concentration of one milligram per milliliter is evaporated exceedingly quickly at temperatures low enough not to damage the molecule, it is obvious that thiotimoline ought to precipitate out of solution only 1.12 seconds *after* all the water has disappeared and not an instant before. Such phenomena have not yet been observed here, but we feel it to be only a question of developing appropriate techniques.

Endochronic Filtration: No factor has served to retard thiotimoline research as much as the difficulty of obtaining pure substance. Since relatively small traces of impurities mask the endochronic properties of thiotimoline and interfere with the reproducibility of quantitative measurements, considerable effort has perforce been expended on its thorough purification. Repeated recrystallizations and resublimations have been necessary. The technique of endochronic filtration has been developed to simplify this procedure enormously.

As described in earlier papers, an extraction of the bark of the shrub, *Rosacea Karlsbadensis rufo* with distilled water at 5° C., followed by lyophilization (*i. e.* freeze-drying) of the extract, results in a faintly yellow powder one milligram of which will dissolve in one milliliter of water in −0.72 seconds. (It is important that this extraction not be extended for too long a period of time as the gradual extraction of the less soluble,

non-endochronic components of the bark will rapidly destroy all traces of endochronicity in the final powder.)

Once an impure powder with significant endochronicity is obtained, only one further step is necessary to obtain extreme purity. The endochronic filter here shown (see Figure 2) is a simplified diagram taken from a detailed report from this laboratory on the principles of its mechanism (3). It is only necessary here to describe the process briefly. The endochronic filter is essentially a device for rapid suction filtration. Stopcocks 1 and 2 are automatically controlled by an electric circuit not shown in this diagram. At the start of the process, stopcock 1 is in the closed position and one hundred milliliters of distilled water are in vessel A. On the sintered glass filter of vessel B, not more than one gram of impure thiotimoline powdered extract is placed. Stopcock 2—which is a two-way stopcock—is so turned as to connect vessels B and C. The electric circuit is then closed, an action which automatically turns on the vacuum pump. Five seconds after the electric circuit has been closed, a timer activates a relay which opens stopcock 1 and *simultaneously* turns stopcock 2 into its other position connecting vessels B and D.

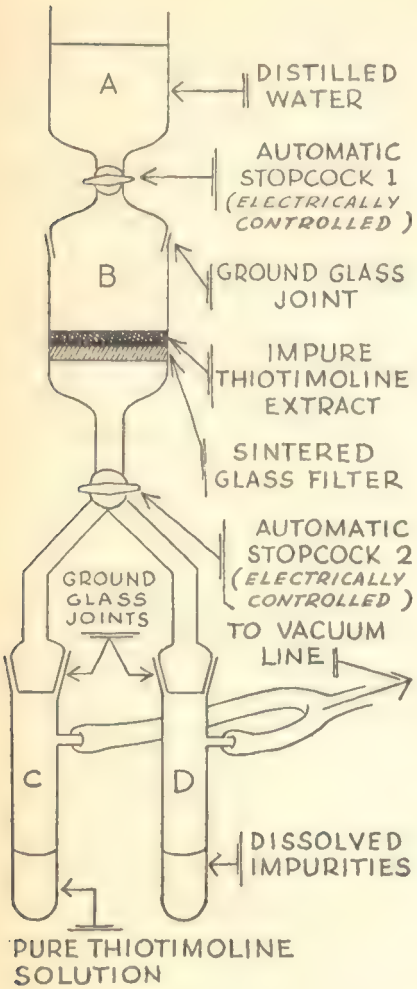


Figure 2

The consequences of such a procedure are plain. At 0.72 seconds *before* stopcock 1 was opened, the thiotimoline molecules in the impure extract had dissolved in the water that was about to fall upon it while the non-thiotimoline molecules remained, of course, impervious to water whose existence was for them as yet only potential. Under the influ-

ence of the vacuum, the dissolved thiotimoline was sucked through the sintered glass filter and into vessel C. When stopcock 1 was opened, stopcock 2 was turned so as to allow any impurities that dissolved in the water, which now *actually* fell upon the extract, to be sucked into vessel D.

The solution in vessel C was lyophilized and one milligram of the white powder thus obtained was found to dissolve in one milliliter of water in −1.124 seconds, a velocity somewhat more negative than had been attained by the use of the most highly purified samples of thiotimoline as otherwise prepared. Trace ionic impurities present were derived, in all probability, from impurities in the distilled water used and did not interfere with the subsequent investigations.

The Endochronometroscope: The endochronometer, described in my previous communication to this journal, is essentially a device whereby a small cell containing powdered thiotimoline interrupts a lightbeam which would otherwise be focused upon a photoelectric cell. Solution of the thiotimoline renders the cell transparent and the photoelectric cell is activated, closing the circuit and recording the exact time of solution. Since the water is added by an electrically-controlled automatic pipette, the time of addition of water can also be determined with great precision. The time of solution minus the time of addition is the "endochronic interval."

It has been increasingly apparent to workers in this laboratory that attention must be paid not only to the time at which thiotimoline dissolves but to its manner of dissolving. Lumbegger and Hophni of this laboratory have recently described a motion picture micro-camera—an "endochronometroscope"—attachment, by use of which fine deviations from the solubility norm can be detected (4). Although the original purpose of this was to test certain theoretical implications of the endochronic carbon atom hypothesis, endochronometroscopy proved of the utmost importance in a series of experiments to be described below.

Willometry: It will be noted that the endochronic filter as well as the endochronometer are adjusted to work with a minimum of human interference. The necessity of this is obvious. Useless speculation has been brought forward in the past as to the possibility of withdrawing water *after* the thiotimoline has been dissolved and *before* the water has actually been added, thus "fooling" the thiotimoline into dissolving in water which never arrives. In such a ridiculous attempt, needless to say, only the experimenters are fooled, since what they propose—if indeed they propose it seriously—runs counter to the second law of thermodynamics, as elementary calculation will show (5).

Nevertheless, with ample supplies of

thiotimoline of extreme purity finally made available by the use of endochronic filtration, it became possible to determine the effect of human will upon the negative time of solution—i.e. the endochronic interval—and, conversely, to measure the strength of the human will by means of thiotimoline. The resultant technique has been given the name, *willometry*.

It was early observed, for instance, that strong-willed, incisive personalities, achieved the full endochronic interval when adding water by hand. Having made up their minds, in other words, that they were going to add the water, no doubts assailed them and the final addition was as certain as though it had been mechanically arranged.

Other individuals, of a more or less hesitating, self-deprecatory nature, yielded quite different results. Even when expressing themselves as entirely determined to add the water in response to a given signal, and though assuring us afterward that they had felt no hesitation, the time of negative solution decreased markedly. Undoubtedly, their inner hesitation was so deeply bound with their unconscious mind and with super-ego-censored infantile traumas that they were completely unaware of it in any conscious manner. The importance of such physical demonstrations, amenable to quantitative treatment, to the psychiatrist is obvious.

In a mass willometric experiment, eighty-seven male students of the freshman class of Comstock Lode College (Crowded Creek, North Dakota) were used as subjects. It was found that the distribution of will power varied in the ordinary bell-shaped probability curve. Two students yielded a time of solution of −1.10 seconds or better on all occasions and two students yielded an endochronic interval that was actually positive. It was interesting to note that among the female students—sixty-two of whom were used in a similar experiment—the probability curve was somewhat skewed in the direction of stronger will (see Figure 3). Whereas the observed mean time of solution for all male subjects was −0.625, that for females was −0.811. This confirms a sex difference which

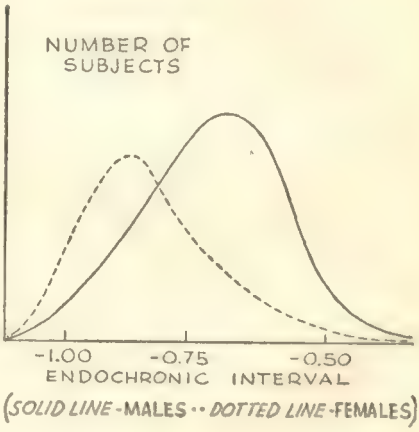


Figure 3

has been intuitively apparent—to males, at least—through all of recorded time.

There is reason to think that the endochronic interval may vary with the immediate state of mind of a subject. One student, E. H., having yielded endochronic intervals of from −0.55 to −0.62 over a period of dozens of experiments, suddenly jumped the interval to −0.92. This increase in self-confidence appeared quite remarkable. The technician in charge of the experiment on close questioning insisted that no untoward event had taken place and, indeed, stated that the subject had done nothing more than to express the desire for a walk in the countryside that evening and that the technician had agreed to accompany him. Since E. H. was not particularly athletically inclined, it seemed strange that the prospects of a walk should so affect him. To test whether the effect could be rendered still stronger, the author of this paper voluntarily offered to accompany E. H. as a third member of the party. Unaccountably, the endochronic interval dropped to −0.14 with the very next test. If we may be allowed some speculation, it may be that we are here in the presence of another sex difference made apparent by thiotimoline research, since the author of this paper is male—as was the student—while the technician is female—very pronouncedly female, in fact. Some facets of this obscure situation have been commented upon very recently by McLevinson (6).

Schizophrenic Willometry: Lumbegger, of this laboratory, in the course of his endochronometroscopic observations on both mechanically and manually induced solutions of thiotimoline was the first to observe the anomalous behavior of thiotimoline under the influence of particular subjects (7). Ordinarily, the thiotimoline powder dissolved with great rapidity—the time between completely solid state and completely dissolved state being less than a thousandth of a second—and with no perceptible unevenness. In the case of one subject, however, J. G. B., it was found that, strangely enough, there was a perceptible time during which part of the thiotimoline had dissolved and part had not. Dozens of repetitions of the experiments showed beyond all doubt that there was no flaw in the endochronometer or endochronometroscope. A series of stills published in Lumbegger's paper, referred to above, make that quite clear.

The subject, however, when subjected to thoroughgoing psychoanalysis, promptly displayed hitherto undetected schizophrenic tendencies. The effect on the endochronic interval of two personalities of differing degrees of self-confidence within a single mind is obvious.

Through the kindness of Dr. Alan E. Windischgraets of the Psychoso-

matic Institute (Potlikker, Oklahoma) we were able to make use of one hundred fifty patients of varying schizophrenic tendencies as subjects for willometric studies.

These studies quickly indicated that three types of schizophrenic deviations from the normal may be detected endochronometroscopically. These may be termed *horizontal schizophrenia*, *vertical schizophrenia*, and *diffuse schizophrenia*. In horizontal schizophrenia, the thiotimoline sample differs in its behavior about a horizontal line of cleavage. More commonly the upper half of the sample dissolves as much as 0.01 seconds before the lower half. This may be referred to as the *supra variety*. Less frequently it is the lower half that dissolves first and this is the *infra variety*.

Similarly, vertical schizophrenia evidences itself in variable solubility about a vertical line of cleavage. Here the left half of the sample dissolves first in about half the cases, and the right half in the other half. These are known respectively as the *levo variety* and the *dextro variety*. It has been a matter of some remark as to why the two varieties of vertical schizophrenia should be of equal occurrence while those of horizontal schizophrenia should be so unevenly represented in favor of the supra variety. There have been suggestions that the gravitational field plays its part in this, but no direct experimental evidence exists.

In diffuse schizophrenia, no neat dividing line exists between early-dissolving thiotimoline and late-dissolving thiotimoline. Rather the substance seems to dissolve in ragged

TABLE 1

Distribution of Schizophrenic Classes among the Patients at the Psychosomatic Institute

Total Number of Patients Studied		150
Total Heteroschizophrenics		145
Vertical Schizophrenics	68	
Levo Variety	33	
Dextro Variety	35	
Horizontal Schizophrenics	70	
Supra Variety	62	
Infra Variety	8	
Diffuse Schizophrenics	7	
Total Isoschizophrenics		5

patches randomly distributed through the body of the sample.

All these varieties of schizophrenia described above may be lumped together under the general name of *heteroschizophrenia*, since two personalities of different wills are involved. The heteroschizophrenics comprise by far the majority of the subjects tested. There remain, however, a few subjects who, from a psychiatric standpoint, show all the symptoms of schizophrenia, but who nevertheless show no discontinuities in the endochronic interval. The conclusion at which we have arrived is that these subjects possess two personalities of equal will and are, therefore, *isoschizophrenic*.

A summary of the distribution of patients in the various schizophrenic classes is given in Table 1.

Each patient, in addition to being typed as one of the varieties listed above, can be further graded in accordance with the amount of deviation in the endochronic interval of the early-dissolving portions of thiotimoline and the late-dissolving portions. Since the maximum difference observed is about 0.010 seconds and since the endochronometroscope can easily detect time intervals of 0.001 seconds, ten grades may be distinguished, Grade 10 shows 0.010 seconds of deviations, Grade 9 shows 0.009 seconds of deviation and so on down to Grade 1 which shows 0.001 seconds of deviation.

In general, the lower grades are more frequently populated, as may be seen in Table 2. (It will be noted that only one hundred forty-five patients are listed in Table 2. It is obvious that in the case of the five isoschizophrenics, Grade numbers are not applicable.)

TABLE 2
Grade Frequences in all Varieties of Schizophrenia

Grade 1	23	Grade 6	8
Grade 2	25	Grade 7	6
Grade 3	29	Grade 8	9
Grade 4	22	Grade 9	5
Grade 5	14	Grade 10	4
Total Heterschizophrenics			145

The value of such a subdivision of schizophrenia may well be said to be of incalculable potentialities and, indeed, to found a new science of *quantitative micropsychiatry*. How much more useful it is to say of a patient that he is a vertical schizophrenic, levo variety, Grade 3, than simply to

say that he is schizophrenic.

If a small drawback exists in the magnificent structure now being erected, it is that all efforts have been so far unavailing in the attempt to find any medical meaning in our micropsychiatric divisions (8). This failure of application should not, however, be allowed to diminish the aesthetic beauty and abstract symmetry of the new technique of endochronometroscopy and the science of quantitative micropsychiatry to which it has given birth.

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THE END

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THE MYSTERY OF THE BLUE MIST OF MARS

BY R. S. RICHARDSON

***Observing** a wisp of mist on the surface of a nearly airless planet some forty megamiles away is tricky business. Identifying its nature, however, is a lot tougher!*

To most people "blue mist" means the dark depressing cloud which envelops us when we wake up Monday morning. But to an astronomer the words have quite a different significance, especially if the astronomer happens to be a planetary man. For to a planetary man blue mist means only one thing: the mysterious haze or veil which prevents us from seeing the surface of Mars in blue or violet light. Today the blue mist is pushing the canals hard for top place on the list of Things We Would Like to Know about Mars. One reason in particular why we would like to know more about the blue mist is that it can give us information on the biggest question of all—the question of life on Mars itself.

While the discovery of the canals is now three-quarters of a century old the blue mist is a comparative newcomer among Martian phenomena. It has long been known that the appearance of Mars is quite different in light of different colors. This fact seems to have been first recognized by a Russian named Tikhoff about forty years ago, who photographed the planet in green, orange, and red light. He found that the familiar surface markings showed distinctly in red and orange light but were barely discernible in green, which led him to predict that they would be missing entirely in blue and violet. This prediction has been abundantly confirmed by later work. In blue and violet light the disk of Mars is a blank except for the polar cap which appears even more conspicuous than on the red

photographs, a circumstance that does not appear to have been foreseen by anyone.

These results might have been predicted with considerable confidence without taking any photographs at all. We know that longer wave-length red light is more penetrating than blue. Or putting it the other way around, the shorter wave-length blue light is scattered more by air molecules than red. Every camera fan who likes to experiment with different emulsions and color filters is well aware of this effect. Thus a distant mountain which stands out sharp and clear when snapped in red light may not show at all when photographed through a blue filter. The blue images almost invariably appear dim and washed out compared with those taken in red.

Therefore, when applied to Mars, we would expect red light to penetrate the planet's atmosphere and show us the surface markings, while blue light would show only the outer atmospheric shell. In this case the observations are in exact agreement with theory. But Venus was a surprise for it will be remembered that the surface markings show only in violet light on that planet.

Evidently the atmosphere of Mars is similar to our own in that it serves as a good shield against the ultraviolet radiation from the sun. At the surface of the Earth our atmosphere stops all ultraviolet light shorter than wave-length 2900 A. The constituent that is most effective in this respect is ozone at an altitude of about twelve miles, although it also occurs considerably higher. If brought to sea-level, the ozonosphere would form a shifting unstable layer of molecules (O_3) scarcely a tenth of an inch in thickness. Yet this is all that protects us from a flood of ultraviolet radiation that might blind and even kill us eventually if the Earth were exposed to it for long. It is often considered as providential that the Earth has an ozone layer. But of course this is arguing the wrong way around. If the ozone layer were not there, we would doubtless have become highly resistant to ultraviolet light by this time.

Now we know very little about the atmosphere of Mars; in fact, practically all our knowledge on the subject is negative in character. We can only tell what we *don't* know. But according to the latest expert opinion on the subject the atmosphere of Mars consists of the following by volume: 95.5% nitrogen; 1.2% argon; 0.25% carbon dioxide; oxygen, water-vapor, and other gases less than 0.05%. (I would like to know how they got the decimal points on the figures.) If there is no oxygen on Mars, then there can also be no ozone layer.

It is true that, if there was a little oxygen present long ago, the ozone layer would have been formed near the surface instead of several miles up. The reddish tint of the deserts

has been ascribed to iron oxides due to such a chemically active gas. The idea is less attractive now than when first advanced eighteen years ago, since observations made in 1948 revealed that the red deserts do not reflect like iron oxides. This has ruined several dramatic accounts of how death came to the Red Planet, with its picture of the Martians fighting a losing battle with their dwindling supply of oxygen. (A few managed to survive by taking cover under glass domes like inverted casserole dishes.) But the most recent work indicates that the deserts may consist of a hydrated ferrous oxide called limonite. More observations will be needed to settle the matter.

While stories and articles about Mars continue to warn of the dangers of exposure to ultraviolet radiation, actually the Martians would seem to be pretty well fixed in this respect. If they cannot boast of an ozonosphere, they can still point with pride to their blue mist, but with this difference: while the amount of ozone in our atmosphere varies during the year there is always plenty on hand to stop the ultraviolet light cold. But on Mars SOMETHING can happen on rare occasions that clears out the blue mist to an astonishing degree.

The most remarkable instance on record occurred on the nights of May 20th and 21st, 1937. Ordinarily the blue mist is so thick that even such intense markings as the Syrtis Major are invisible on photographs taken in blue and violet light. On these nights, however, the Lowell Observatory reported that the Syrtis Major appeared on blue photographs so distinctly that one might easily have supposed they were the ordinary yellow images of the planet.

It might be objected that perhaps the change was not in the atmosphere, but in the dark markings themselves. But this could not have been the case since photographs taken on the same nights in yellow and red light showed the markings as usual. Also, the change was not planet-wide but was restricted to an area extending over roughly ten per cent of the surface centered about the Syrtis Major, and including part of the Mare Erythraeum and Sabaeus Sinus, as well as a portion of the Thoth-Nepenthes and Nilo-Syrtis canal systems. Other markings nearby did not appear in blue light as usual. There seems no escape from the conclusion that the change was caused by some extraordinary meteorological phenomenon which produced the temporary clearing observed.

The nature of the blue mist is still a matter of speculation. Obviously it is not a permanent constituent of the planet's atmosphere. The most likely material would seem to be fine dust particles or tiny crystals of ice or frozen carbon dioxide gas. We could tell much better if we knew something about the height of the

blue mist. The suggestion that the haze consists of ice particles receives some support from the sun dogs and solar halos seen in our own atmosphere on cold clear days.

Now how can the blue mist give us any information about life on Mars?

The best evidence—indeed the only evidence—that there is life anywhere in the universe besides the Earth is found in the seasonal changes of the dark markings of Mars. After the polar cap begins to melt in the spring the dark markings in that hemisphere grow in size and turn a deeper shade of green. In the autumn and winter the markings are much fainter. While these changes strongly suggest the growth and decay of vegetation, the case is by no means proved. An alternative hypothesis is that the dark markings are covered by alkali salts which absorb water from the evaporating polar cap, an idea that was put forth about thirty-five years ago by the Swedish chemist and Nobel prize winner, Svante Arrhenius. In view of the fact that there is probably not enough water on the whole of Mars to fill the Great Lakes the hygroscopic salt theory seems rather far-fetched, yet it continues to turn up with monotonous regularity year after year.

Let us consider the following chain of reasoning:

Large organic molecules are destroyed by ultraviolet radiation.

The blue haze shields the surface of Mars from ultraviolet radiation.

Therefore, if there is plant life on Mars it will not have developed a resistance to ultraviolet radiation.

On rare occasions the blue haze clears away allowing ultraviolet radiation to reach the surface.

The damaging effect of excessive exposure to ultraviolet radiation may produce detectable changes in the color of the dark markings.

Hence, if measures show a definite change in the tint of the dark markings during a period of blue clearing it would be favorable to the vegetative hypothesis.

Such measures were made recently by Seymour L. Hess, a meteorologist, using photographs taken at the Lowell Observatory when Mars was within thirty-nine million miles in 1939 and 1941. His measures were made on the intensity of the Syrtis Minor relative to the desert region surrounding it which was presumed to have remained constant. In October, 1941, there was a period of blue clearing which lasted for ten days. The Martian season at the Syrtis Minor corresponded roughly to that of late summer in Australia.

The measures showed that during the normal blue haziness the Syrtis Minor was fading or becoming browner in color, but that the trend was halted during the clear period. Hess interprets this as indicating a normal seasonal color variation before and after clearing which was interrupted by the injurious effects of the nearly full

strength ultraviolet radiation. Thus the 1941 observations favor the hypothesis that there is vegetation on Mars and that the blue haze is an important factor in protecting the growth.

In 1939 the photographs of Mars taken at the Lowell Observatory showed no clearing of the blue haze and the changes in tone of the Syrtis Minor seem to correspond to the natural seasonal variations. Unfortunately there are gaps in the record so that the blue haze might have cleared away for a few nights and never been noticed. An astronomer at another observatory reported that his photographs of Mars in 1939 show some evidence of clearing. Thus the results for that year are inconclusive.

This is a highly ingenious method of extracting information on an exceedingly difficult subject and further results will be awaited with much interest. Mars was close enough in May, 1952, for some work to be done; there will be a still closer approach in June, 1954; and a very close approach of thirty-five million miles in September, 1956. The planets are the most neglected bodies in the sky but there is probably more interest in them at present than at any time during the last twenty-five years. Credit for this wave of enthusiasm sweeping the astronomical profession is due largely to Dr. G. P. Kuiper of the Yerkes-McDonald Observatories, who almost single-handed has shown that there are still possibilities for discovery in this field.

If projects now under way at several large observatories turn out successfully, we should know much more about the blue mist by the end of 1956 than at present. In any case, think what a fine subject it would make for a story of famine on Mars caused by villains from the Earth seeding the atmosphere of the planet.

THE END

THE ANALYTICAL LABORATORY

Briefly—very, in this limited space!—the reader votes on the September, 1953 issue. The authors and I alike watch these with interest; somewhere, there's a pattern of what you readers want. Finding it, though, requires data—and only you can give it to us!

Place	*Story*	*Author*	*Points*
1.	What Thin Partitions	Mark Clifton and Alex Apostolides	1.88
2.	Humpty Dumpty	Lewis Padgett	2.28
3.	Gimmick	Katherine MacLean	3.08
4.	The Garden In The Forest	Robert F. Young	3.65
5.	Little Joe	Algis Budrys	4.17

THE EDITOR.

COUNTERSPY

BY KELLEY EDWARDS

An atomic experimental station is not a safe place to be when an enemy is out to accident you to death!

Illustrated by Mirachi

It was a routine operation. He fumbled with the thin spline as he fed it into the test hole, awkward because of the thick rubber gloves, uncomfortable in the heavy white overalls and tight assault mask. His assistant stood by, waiting with the Radiation Monitoring man and his instrument, looking grotesque in the heavy clothing that protected them from radioactive contamination.

The spline stiffened in his hand and buckled. It had contacted the sample, deep in the heart of the massive atomic pile, and its tip had engaged the lip of the sample. He waved his hand to let the other men know, since speech was almost impossible in the assault masks, and the assistant began to reel the spline back into its protective drum. He fumbled a rag around the spline as it snaked out of the hole, wiping off the tiny particles of dirt and grease that the pile had made radioactive. He kept his eyes on the release tool fastened to the side of the test hole, where the tip of the spline would emerge, releasing the sample in the process. The Radiation Monitoring man held his instrument close, watching the needle of the meter. There was no sound except the keening of the spline and his own breathing, muffled by the mask.

Suddenly, without warning, the end of the spline leaped from the pile, pulling the release tool with it, the

thin sample trailing behind.

A muffled yell from the man with the meter, as the sample and release tool fell to the concrete floor. Then a scrabbling sound as the three men spun and ran, awkwardly and with maddening slowness, away from the deadly thing on the floor. Next they were clumping down the stairs, putting concrete walls and floor between them and the sample.

When they reached the landing, he stopped and pulled the mask away from his face.

"What happened, Jack?" He asked his assistant. "The tool and all came out. Didn't you fasten it in?"

Jack pulled his mask away from his face with trembling hands.

"Sure, I locked it in, Ralph," he said. "Something must have gone wrong with the locking mechanism. I'm sure I locked it in."

The man with the instrument slid his mask up over his head and took a deep breath.

"I wish you guys would tell me before you do something like that," he said. "You make me nervous."

Ralph slid out of his gloves, careful not to touch his hands to the outside of the rubber. He dropped them in a cloth hamper marked with a red "Contaminated" sign.

"We can probably get it from the top of the pile," he said slowly. "Jack, see if you can find the twenty-foot fingers and reach down from the top. Drop the thing in a cask and then we can button it up." He took a deep breath of air and let it out slowly. "We were lucky that time," he said. "That was a graphite sample. It might have been the cobalt."

The radiation monitor laid his instrument down carefully.

"You got cobalt in that test hole?" he said.

"Yeah," Ralph said.

"If you intend to pull it out like that, get yourself another boy. I don't want any part of it. Gimme your pencils. You've probably got a week's dose on them."

As Ralph fumbled inside his overalls for the pencils, his mind put items together, unconnected incidents that meant little, tools that failed, warnings that weren't given. It added up, it added up.

Someone was trying to kill him.

Ralph dropped into a chair and reached into his shirt pocket for a cigarette. His hand trembled a little as he lit it. The man behind the desk watched with cold, gray eyes, missing nothing.

"Somebody's wise, Sutherland," Ralph said.

"What gives you that idea, Thaling?" Sutherland said. "You make a slip?"

"I don't know. If I did, I don't know what it is. But somebody is trying to kill me."

The man relaxed back into his chair. "Don't be a sap. They don't kill people unless there's a good reason. If they found out you're working with us, they'd just shy away from you. They wouldn't kill you."

Ralph leaned forward and pointed his cigarette. "How do you know what they'd do? If a man's a spy, he's dangerous. You know that as well as I do."

"Don't call them spies. They're enemy agents. And they won't tip their hand by getting involved in a killing. If they've spotted you, they'll just keep away from you." He paused. "Unless you've spotted them," he added, softly.

"Well I haven't. But too many things have been going wrong. I was on the experimental level this afternoon, taking out a sample, and the release tool failed and the thing came right out in my lap."

"So what?"

"So release tools just don't fail. They're built so they won't fail. This is the first one that's gone bad since this plant started up. Besides, I got a look at it after we'd cleaned up the mess. Somebody had taken a file to it."

Sutherland pulled at his lip and frowned.

"You sure about that?"

"Yeah. And you don't seem very

concerned about whether I picked up a lethal dose of radiation or not."

Sutherland smiled, a thin, ironic smile that fitted his personality to perfection. "If you'd gotten a lethal dose," he said, "you wouldn't be in griping to me. You'd be out chasing some blonde."

"Very funny," Ralph said, annoyed.

Sutherland leaned forward, suddenly, startlingly.

"Who is he?" he barked.

"Who?"

"The agent. You must know, or they wouldn't be trying to knock you off. They wouldn't take that chance unless you know who he is."

"But I don't know."

"Think."

"You sound like an IBM salesman. I don't know who he is. If I knew, I'd tell you. And don't bark at me. I don't like it."

Sutherland leaned back and looked at the ceiling. He gazed at the ceiling light for a long time, not moving.

"We picked up the Seattle contact," he said softly. "We've got the whole chain, now, except the man here who's actually getting the information. We tailed the man in Seattle, and there's no doubt about it." He paused. "He's a cop."

"A cop?"

"That's why it took us so long to find him. I sometimes don't understand these people. He can't be getting much money for it. All we need now is the man here and we can pull in the whole gang."

"And what about me?"

Sutherland lowered his eyes from the ceiling.

"You're going to find him for us," he said.

Ralph made a vulgar noise and ground out his cigarette in the ash tray.

"You're going to find him," Sutherland said, "because now you've got a real motive. He's trying to kill you, and the only way you'll stay alive is to find him."

"Suppose he kills me first?"

"It's up to you to see that he doesn't."

Ralph stood up and put both hands on the desk, leaning over.

"Listen, Sutherland. I didn't ask to get in on this—you asked me. I don't know anything about counter-espionage, and I told you that when I started. I'm a physicist. I like my job and I want to go on living. I'm going to pull out of here, if I have to, but I'm not going to get myself killed by some fanatic. Understand?"

"Apparently you don't understand, Thaling. This man, whoever he is, is going to get you if you don't get him first. It doesn't matter to him whether it's here, or in Chicago, or Los Alamos, or where it is. He's the key man in a big organization, and he's convinced you can nail him or he wouldn't risk trying to kill you. Running away won't help. As long as you stay here

it has to look like an accident. If you run away, we'll find your body some place with some secret documents on it and the newspapers will have a swell spy story—with you as the hero. These guys play for keeps." He smiled. "So do we."

Ralph got back to his office just after noon. Jack and Fred Adams, the technologist, were eating lunch and glaring at a chessboard. Neither said a word as he came in and sank into his own chair.

"You get it cleaned up, Jack?" he asked.

Jack grunted a reply through his sandwich without looking up.

"Where you been, Ralph?" Adams asked.

"Security. Friend Sutherland."

"File violation?"

"No. He wanted me to go to Russia and take over their A-bomb development. He thinks they're doing too well and he wanted me to slow them down a bit. Like I've slowed us down here, he said."

Adams grinned and went back to the chessboard.

"It's your move, Jack," he said.

"It's been Jack's move for two days," Ralph said.

"No," Adams corrected him. "Three days."

Jack moved a piece.

"Check," he said. "Guard queen and rook."

Adams frowned at the chessboard, his sandwich forgotten on the desk behind him.

"That'll teach you to be kinder to me," Jack smiled. "Resign?"

"No I won't resign. Shut up and let me think."

Jack grinned at Ralph and went to work on an apple.

Ralph said, "Did either of you two lovebirds get that high-level chamber hooked up on the rear face?"

Jack shook his head. "I was all involved in getting that sample picked up. I think Fred was asleep most of the morning."

Adams frowned at the chess men without comment.

"I guess if you want anything done around here, you have to do it yourself," Ralph said. He got up. "Have they gotten any results on the film badges?"

"They didn't check them," Jack said. "The pencil readings were low enough so they didn't think it would be worth it. We got out of there pretty fast."

"Yeah."

That time, he thought. *Maybe I won't get out fast enough the next time. And it has to be someone who thought we were going to pull the cobalt. About twenty people could have thought that.*

Ralph glanced at his watch. It was twelve twenty. The discharge was due to start again at one o'clock, so he had time to get his job done on the rear face before the gleaming, deadly

uranium slugs came tumbling out of the tubes.

He called the operations supervisor to get permission, then walked over to the pile building. It bulked large against the gray sky, a mass of concrete and steel pipe with giant water tanks standing, gargantuan and passive, on each side.

As he was putting on his protective clothing the Radiation Monitoring man stuck his head in the door and grinned.

"Haven't you had enough for one day? Or are you going to kill yourself for good this time?"

Ralph's head snapped around and he looked at the man, a cold fear finding his stomach. But the grin was real.

"Yeah," he said.

"That's a good answer."

Ralph shucked on his overalls and went out, around the massive, hulking pile to the entrance to the discharge face. The green light was on over the door.

He climbed the steps, turned, climbed again. Air from the building's cooling-system felt its way past him as he climbed. He opened a door marked "30 foot level" and locked it open. He knew that the green light on the door below had turned to red, and that a bell was ringing in the control room. Four large red lights also went on on the elevator on the other side of the pile, and an interlock opened a circuit so that the charging machines could not be operated. He would not care to have the uranium coming out of the tubes when he was there.

He reached in the pocket of his overalls and pulled out a small plastic cylinder. When you wanted to measure the intensity of radiation in that area, a large chamber was a waste of time.

The leads for the chamber had been installed by one of the instrument mechanics. He found them, their ends neatly taped, lying on the floor of the balcony. He looked down. Thirty feet below him lay the placid, protective water of the great basin. Directly below was the balcony at the twenty-foot level, and the tubes of the great pile, twenty feet away, spread in every direction.

As he worked he turned over in his mind all that he knew about the spy—the unknown who was his deadly enemy. It could be any one of several men. He had seen photostats of the data this man had stolen, and they showed that the man knew what he was doing. This was not the work of an amateur. Operating data, records, the physical constants without which the pile could not be operated—all these things, the important things, and nothing more. Nothing unimportant.

He finished making the connection and started to rise when blackness cut him off from his mind.

First he felt the pain. It came from far away and it got bigger as it came, pounding and throbbing until there was nothing in the world but this pain. He tried to raise his head but the pain slapped it down again, beating at him and making him sick. He opened his eyes and he could see the pain, red pain hammering at him.

Then fear came to keep it company.

He struggled to his feet, pain blinding his eyes, and clung to the railing of the balcony. After a while he could see. He stumbled awkwardly to the door and pushed it. It was locked.

As the pain subsided the fear became more real. Someone had locked him in here with death, a painless death of fierce radiation from the discharged slugs. Maybe he was already dead. If they had discharged while he was unconscious, he was already a dead man. He pounded on the door as sweat broke out on his body.

A loud-speaker blared, "C elevator to control room. All clear to discharge?"

Then they hadn't started. The operator would be looking at the lights now, but they would all be green. The door was closed and the light would be green.

He screamed, "NO! Wait! I'm back here! Wait!"

He knew it was no good. The only microphone was on the rear face elevator, and whoever had left him would be sure it had been turned off.

The loud-speaker chuckled. "If you hear me, waggle the control room," it said. That would be Rowan. He hadn't heard. He was talking to the operator, joking with him as he readied the charging machine.

Ralph looked down at the pile. He could count five tubes which had the caps off so the slugs could come out, all in a row. Those would be the ones they were discharging. Five. And one would be lethal. They were going to kill him five times.

He crouched back into the doorway, hardly breathing, his eyes on the tubes below him. Although the balcony was concrete, it was too thin to afford much shielding. He had calculated, one time, how long a man could live if he were on the rear face of the pile during a discharge. It had been morbidly interesting. He couldn't remember now whether it had been three seconds or thirty seconds. He remembered, inanely, telling Jack that any answer on radiation intensity was good if it was within a factor of ten.

Jack! His mind caught hold of that. Jack knew where he was. Jack and Fred Adams. Was there . . . no. No one else. Only the Radiation Monitoring man had seen him, and he didn't know where he was going. The operations supervisor? No, the man he was after was in his own division. He was sure of that. Jack, then. Or Fred Adams. He saw them, crouched over their chess game, one of them thinking, *This is my chance.*

He looked down, trying to judge

whether he could drop to the balcony below. There was just a chance.

A *chuff*, and the first slug slithered out of the tube below him and hung for an instant before it fell its silent, turning way to the water below. It splashed as the next came after it and then they were almost a stream, arcing gracefully down into the water, filling the air and his body with invisible, lethal radiation. One after another they fell, then one hit the tube below with a clang and spun crazily as it dropped after the others. He crouched back from them, keeping as far away as he could, trying not to realize that he was dead, that he had been killed, that he had maybe a week or maybe a day or maybe just another few seconds.

Then he saw it. He looked again to make sure, leaning out over the balcony to look but he was right—they were the wrong size. They were too long. The uranium slugs were short and the aluminum cans that held them in the center of the pile against the push of the cooling water were long. All the slugs falling below him were empty cans, dummies, radioactive but not as lethal as the fiercely radioactive fission products generated in a uranium piece. He still had a chance.

"One down, four to go," the speaker above him announced.

It would be a matter of seconds, maybe half a minute, before they went on to the next tube. He had that long to live.

He pulled open his overalls and unbuckled his belt, almost tearing it off in his haste. He wrapped it around the lower bar of the railing and looped the end through the buckle. Without testing its strength, he wiggled through the railings and dropped, hanging onto the belt. It slipped through his hands, wet with sweat, slithering through his hands as he fought to hold on, to swing in under the balcony, slipping, and then it was gone and he was falling toward the deadly water below, his head spinning as he reached frantically for the railing as it went past. He caught it with an arm that sprang sudden pain but he held on, his body hitting against the concrete of the balcony. He pulled himself up frantically and tumbled over the railing. He got to his feet and ran for the door, throwing his weight against it.

It was locked.

The tube to be discharged was just at the level of his eyes, now, but it didn't matter. When you were that close a few feet didn't make any difference. He pushed at the door, throwing the whole weight of his body against it. It didn't move.

Chuff. . .

He didn't look. He knew it was beginning, but he couldn't bring himself to look at it, to see the slugs spinning down past him.

He remembered the interlock suddenly and fumbled in his pocket for his knife as he heard the splash of the first slug as it hit the water below

him, closer now.

He got the knife out. The latch of the door, he knew, had the interlock connection on it. He pulled the blade out and jammed it into the latch at the edge of the door. It didn't move. He jabbed again, fiercely, as the slugs plopped into the water below him and he felt it give a little. He didn't know if he'd moved it enough but he kept the knife there, not looking over his shoulder at the tube, sweat making the knife slip in his hand—and the slugs had stopped.

"What are you doing?" the speaker blared above him.

There was a silence as he pushed at the knife, using his other hand to hold it against the latch.

"If there's someone on the rear, answer!" the speaker bawled angrily.

He clung fiercely to the knife, holding his life in his two hands against the interlock.

"Well, go up and see," the speaker said.

He held the knife there, his hands numbing and beginning to hurt, his head throbbing again, until he heard someone on the other side of the door.

"Let me out!" he yelled.

Someone said something, but the words were muffled by the heavy door. There was a scrabbling, then silence. The man had found the door locked, and had gone back down for the key. Maybe. Maybe he hadn't heard. He pushed frantically at the knife. They could by-pass the interlock. They could switch it out of the circuit and go on with the discharge if the man hadn't heard him. Why hadn't he yelled again? Why hadn't he screamed and yelled until the man was sure to hear, until the walls vibrated with the sound of his voice?

Then, suddenly, without warning, the door opened and he fell through it onto the concrete of the corridor, his knife clattering along the floor as he let go of it to break his fall.

The control room operator stood over him.

"Doc," he said, "what were you doing in there? You mighta been killed."

He caressed the cool concrete, not moving, breathing deeply as life flowed back into his body.

"Were you in there when they discharged that last tube?" the operator asked.

Ralph managed to nod his head, yes.

"You were lucky it was a dummy tube. You'd have been fried sure if it hadn't been." He leaned down, helping Ralph to his feet. "Come on out of here now. The guys on the front are getting impatient." He closed the door.

Ralph started to stumble down the corridor, and the operator said "Hey!" Ralph turned. The man was pointing to his feet.

"Take off your shoe covers. You'll track contamination all over the place."

Mechanically, without thinking about it, Ralph slipped the canvas covers off his feet and dropped them into a hamper. He slipped off his overalls and left them with the shoe covers.

"I gotta get back to the control room and tell them they can start again. You gonna be all right?"

Ralph nodded dumbly. The operator went on down the corridor and down the stairs, leaving Ralph standing against the wall, breathing deeply.

Jack Darron, he thought. Jack or Fred Adams. They might have told someone else, but probably not. He shook his head, trying to realize that the danger was gone. The slugs would be dropping again, but there was a heavy steel door between them. They were impersonal again, not a silent killer of men.

He walked down the corridor and down the stairs, his feet dropping on each step heavily as he walked. He stopped at the bottom and, from force of habit, stood on the five-fold counter and thrust his hands into the openings. He expected the slow *click—click* of the cosmic ray background, but he didn't hear anything. He looked at the dials. They were standing still, not moving. The neon bulbs above each register were glowing orange, unwinkingly. The machine was jammed.

He stepped off the machine and the lights went out as the overloaded registers came back into play. He

looked at his hands and feet, expecting to see something, but there was nothing to see. There seldom was. He had picked up a load of contamination on his hands that was jamming the machine.

There was a washroom down the hall. He held his hands out from his body, backing through the door in order not to spread the invisible contamination. A wash basin, set off by itself, was marked with the red and yellow stripes of contamination. He worked the pedals with his feet and the water came, too hot. It was always too hot. A powder dispenser dropped yellowish grit into his hands as he pushed his shoulder against the lever.

Ralph washed his hands methodically, up onto his arms, washing the gritty soap off and starting again, many times. He dried his hands on a paper towel, then started all over again. The second time, he went out and put his hands in the counter again. They were clean.

He's gone too far this time, he thought. Now I can find him. The contamination had to come from the corridor floor; the only other thing he had touched was the door and it was kept clean. But the balcony floor wasn't—that was why he had worn shoe covers. Whoever had hit him had tracked the contamination out into the corridor. If he had tracked it out, it was on his feet. All he had to do was find the man with hot feet.

The tall radiation monitor was in his office when he walked in. Ralph pointed to his cheek.

"I think I've picked up some curd on my cheek. Will you check it?"

The man unfolded himself from his chair and picked up an instrument. He detached the probe and passed it around Ralph's face.

"You been sticking your face in the wrong places again?" he asked innocently. He glanced down at the meter. "Yeah," he said. "You picked up a good dose. Spread it around any?"

"I don't think so. I was pretty careful about it."

The man picked up a sponge and a can of powder. "Get any on your hands or feet?"

"Hands. It washed off."

"Nuts. I was hoping I would get to take the steel brushes to that kisser of yours."

He wet the sponge, dumped powder on it, and motioned Ralph over to the sink in the corner of the office.

"I just love to wash people's faces," he said. "It makes me feel so parental. Know what I mean?"

Ralph knew better than to open his mouth in reply. A little disappointed, the tall man slapped the sponge against his face, rubbing the grit around the area of his cheek and forehead, wiping it off with rags that he dropped in a hamper. It took quite a while.

"I guess you're clean," he said

finally, but not too cheerfully.

"Had any other customers lately?" Ralph asked.

"Yeah. Some guy in Transportation had it all over his pants." He chuckled. "We had to take them away from him."

"Nobody in Technical?"

"No. Surprising, isn't it?"

Ralph left the office, thinking, *he's still got it on his feet. One of them will have it on his feet.* He turned suddenly and went back into the office.

"Can I borrow your instrument for a while? I'd like to check on something."

"Can't do it. Against the rules."

"I know that. Can I borrow it?"

The tall man grinned. "Sure. Just don't bust it up."

Ralph slid the probe back in its holder, turned the instrument to "wait" and headed back for the corridor that led to the rear face of the pile. When he got there the red light was on. A brief survey of the concrete around the door was all he needed. He had come this way.

He followed the invisible footprints down the corridor, stopping occasionally to take a reading. They led past the washroom and out the door that led from the pile building. He lost them in the gravel outside.

He went into the operations office and dialed a number on the telephone.

"Sutherland? This is Thaling. I've got him. Hurry! How soon do you think you can get out here?"

"Are you sure?"

"Yeah."

"Who is he?"

"I don't know yet, but I will in about five minutes. Stop Adams or Darron from leaving the area. I'm not sure which one it is, but I'm going now to find out. And bring some help."

"Don't get excited, Thaling. He won't have a gun—he can't get it past the frisker. I'll be there in twenty minutes."

"O.K. I'll meet you at the gate."

Adams was the only one in the office when he got there. He set the instrument down carefully on the floor.

"Get it done?" Adams asked.

"Yeah. Where's Jack?"

"He went over to the pile building a while ago. He hasn't come back yet. Why the snooper?" He pointed to the instrument.

"Just checking on something. I had a little contamination on my hands and I thought I might have left some around the office."

He released the probe and waved it past his desk, past the swivel chair and around the floor. Adams watched him, interested. He moved over to Jack's desk, around the chair and the floor. There was a little on the floor, enough to raise the needle above background. He moved over toward Adams, waving the meter around his desk, past his arms, down his legs and

around his feet. It went off scale.

He looked up suddenly. Adams was looking at him, mildly interested, as if watching a chess game. Ralph didn't see the blow coming until it was almost on him and he rolled with it, but it caught him just the same, blurring red as he tried to see, grasping for the sudden shuffle of feet and then he was on his hands and knees and things began to clear.

Adams was gone. He stumbled to his feet and saw him through the window, running in a long, easy jog. He disappeared into the guard shack in front of the pile building.

Ralph reached for the phone, hurriedly dialed a number. The phone at the other end rang once, stopped agonizingly, rang again. Someone picked it up.

"Control room."

"This is Thaling. Get this straight. Fred Adams just went into the building. Stop him. He's a spy. Got it?"

"Sure, Ralph. I got it. Bother me some other time, will you? I'm busy."

"I'm not kidding, you knothead. Stop him. He's dangerous."

"Sure, sure," the man said, very slowly. "Just take it easy. Shall we shoot him on sight with the machine gun, or drop an atomic bomb on him?" He chuckled loudly at his own wit.

Ralph choked back a screaming, obscene reply and swallowed noisily. "Is the supervisor there?" he asked.

"Sure," the man said, "but he's busy. I can't bother him now."

"Listen," Ralph said slowly, intensely. "This is Thaling, of Technical. I don't know who you are and I hope I never find out. Put that supervisor on or I'll come over there and tear you apart. PUT HIM ON!"

"O.K., O.K.," the man said. "Don't get huffy."

The phone clunked as the man set it down and he could hear a muffle of voices. It went on for a terribly long time. Then the phone was picked up again.

"This is Cease. What's all this about a spy?"

"This is Thaling, Walt. It's on the level. Fred Adams—you know him, our technician—it sounds silly, I know, but it's the goods. He's in the building right now. I don't know what he'll try to do, but you've got to stop him. I'll come right over. Sutherland's on his way here right now. If you find him, hold him. Got it?"

"Is this a gag, Thaling? If it is, you'll never forget it. I'll promise you that."

"It's not a gag, Walt, believe me. Just get Adams. And hurry!"

"O.K., buddy," Cease said.

Ralph dropped the phone onto the cradle and shook his head a little to clear it. Pain stung him again and his head began to ache. Then he thought of Adams, loose in the pile building, and he forgot the pain. He grabbed up the phone again and dialed.

"Guard house, Smith speaking."

"Smith, this is Thaling—Technical.

Sutherland from Security will be coming through the main gate pretty soon—"

"He's here right now. Want to talk to him?"

"No. Just tell him Thaling called, and to meet me at the pile building. O.K.?"

"Sure," Smith said. "I'll tell him."

Ralph dropped the phone and started for the pile building, running.

Cease saw him as he entered the control room.

"Oh, there you are," he said. "Now what's all this about Adams? He isn't in the building."

Ralph felt a pang of fear touch him. "You haven't found him yet?"

"No. We've been over the whole place and he isn't here. Are you pulling my leg, Thaling? I told you—"

"It's on the level, Walt—honest. He knocked me on the head and left me on the rear face while you were discharging. He—"

"Was that you?" Cease thundered. "I wondered what lamebrain was fool enough to get caught in there. Do you realize you held up the discharge for fifteen minutes? Of all the stupid, moronic—"

"Will you shut UP?" Ralph yelled at him. "I told you he knocked me on the head. Why do you think the doors were locked? Why was the mike on the rear elevator out of whack? Do you think I *wanted* to get caught in there? Wise up, Walt. He's playing for keeps. He knows we've found him. He can't get away now. But he can still hurt the pile—he knows all the weak spots. That's probably what he's doing right now—looking for a weak spot."

Cease looked at him uncertainly for a minute.

"Where would he go?"

"Where would you go if you wanted to put the pile out of commission?"

"Here," Cease said, "or—"

They turned together and looked at the lighted panel that showed what doors were open. Three lights were red.

"Where are they?" Ralph said.

"Fan room, that's O.K.; twenty-foot level, that's your work, friend, you shorted out the interlock—and the far side door. Nothing wrong there."

"He could have closed the door after him."

"I know it," Cease said irritably. "Fat lot of good that does us."

"He's in the heat exchanger," Ralph said suddenly.

"How do you know?"

Ralph kicked himself mentally. "Because I told him to go there. We got to talking, one noon, and he asked me where the most vulnerable spot of sabotage would be. I told him the heat exchangers."

"That was big of you," Cease said.

"I didn't know who he was, then."

"He can't do too much, though. He can't get at the sodium system

through the shielding tank, unless he wants to kill himself."

"I told him that, too," Ralph said softly. "He can drop an icepick through the trap at the top of the water tank and pick it up with the mechanical fingers you use for remote maintenance, and jab holes in the inner tank and the sodium tubes at the same time. The sodium would be solid, since you're down. When you heat up the tubes you'll get molten, radioactive sodium into your steam system and the shielding tank. It'll blow, and you'll have hot sodium all over the place."

Cease looked at him incredulously.

"And you told him all this?"

Ralph nodded his head.

Cease looked at him for a long minute, disgust distorting his face.

"That was very neighborly of you," he said softly.

"But we can still get him," Ralph said hurriedly.

"How? If he locked the door from the inside, we'd have to burn through it with a torch. By that time he'll be ready to come out and our heat exchanger will look like a Swiss cheese. We'd never get all the holes plugged remotely. And it only takes one."

"Drain the shielding tank," Ralph said.

"And leave the sodium unshielded? Are you trying to kill us all?"

"You can evacuate that side of the pile. As soon as he sees the water come down past the viewing plate, he'll know what's happened. He'll come out."

"O.K., we'll do it," Cease said. "But he won't come out."

"Why not?"

"Tolerance radiation with that shielding half down is less than a second. Lethal dose in about two minutes. It takes the tank ten minutes to drain, full open. He'll be dead by the time he sees the water level."

Ralph turned as Sutherland came into the control room. Cease was barking over the intercom to clear the side of the pile the heat exchangers were on, making sure everyone was leaving.

Ralph told Sutherland what had happened.

"You weren't very bright to tell him all that," Sutherland said. "We've told you guys not to talk about things like that."

Ralph said nothing.

"How long did you say it would take to drain the tank?"

"Ten minutes."

"And how long has he been in there?"

"I'd guess—maybe ten minutes."

"And how long would it take before he would be ready to start punching holes?"

Ralph swallowed uneasily. "About ten minutes."

Sutherland's cold eyes glinted at him. "Then he's about ready to start now."

"If he's in there."

"Is there any place else he could be?"

"No."

"He's got to be stopped," Sutherland said.

"We can't get at him. The door is solid steel."

"You told him what to do," Sutherland said. "You figure out a way to stop him."

He turned away and sat down on a chair, crossing his legs. He took out a cigarette and very carefully lighted it.

"Can you reach him on the intercom, Walt?" Ralph said. "Maybe I could stall him."

"I tried that," Cease said. "I get an open line hum when I switch to that station. He's jerked it out. Probably smashed all the other instruments in there, too," he added unhappily.

"I hope so," Ralph said suddenly. "That all takes time. Look, Walt. There's a ventilator over the door, isn't there? Up near the ceiling?"

"Yes. So what?"

"If I get a ladder, I can talk to him from up there. Maybe I can stall him. I can tell him we're draining the tank."

"Yes, and you'd get a fine blast of radiation, even through the steel, as we drain the tank. Nothing doing."

"Let me try," Ralph said.

Cease looked at him for a moment.

"I told him to go in there," Ralph said. "Let me try."

"All right. Get Rowan to help you."

He climbed the aluminum ladder awkwardly, carrying a wad of cotton in his left hand. He reached the top and looked back, as the ladder swayed a little. Rowan was gone. He turned to the ventilator and tried to see in, but it was offset to shield against radiation. He put his mouth close to it.

"Adams!"

There was no answer.

"Adams! This is Thaling. Listen to me. Come on out of there. You haven't got a chance. They're draining the shielding tank. As soon as the water starts to drain there'll be nothing between you and the sodium. You'll be killed. Do you hear me?"

He listened carefully. He thought he heard a scraping of feet, but he wasn't sure.

"Listen to me, Adams. They're draining the shielding tank. Can you hear me?"

This time he was sure he heard something. Feet shuffled hurriedly against the concrete floor, and then he heard a metallic thump. Adams had opened the trap door at the top of the shielding tank. He heard a splash, and he could see in his mind the small piece of metal dropping into the tank, probably filed to a needle point. Sounds told him Adams was climbing down now, to get at the mechanical fingers. He would pick up the pointed metal and begin punching the holes.

"Listen to me! They'll be starting any minute now. The whole side of the pile has been evacuated. You haven't got a chance!"

He heard the slight squeak as the mechanical fingers were turned in their water-tight bushing.

"Adams, listen. Maybe you don't believe me. I've got a couple of radiation pencils here—the kind you can look into. I'll drop them through the ventilator, and you can read them. Then you'll know I'm telling the truth."

He pushed the pencils into the ventilator, cotton wrapped around them to keep them from discharging when they hit the floor. He pushed them as far as he could.

"Did you get them?"

He waited for a moment, then he heard a muffled reply.

"No."

He pushed his hand into the opening, stretching to its fullest limit. He could just feel the cotton with the tips of his fingers. Behind him, in an office around the bend in the corridor, an intercom muffled, "The tank valve is open. Water coming down. Get out of there, Thaling!"

"Listen, Adams. They're stuck. Just a minute."

He fumbled in his pockets futilely for a minute, looking for something to push into the ventilator.

The intercom said, "Get out of there, Thaling. You're getting fried. Get out of there!"

He pulled his key ring out of his pocket and fumbled with the clasp on the chain. It refused to come loose. He jerked it suddenly, breaking the clasp, then held the end of the chain between his fingers.

"Just a minute, Adams," he called frantically.

He threw the keys and key ring into the ventilator opening. They struck the cotton softly. He pulled them back with the chain and threw them again, pulled them back and threw them again, then again, and again. They struck metal with a clank.

"Adams!"

"Thaling, if you don't get down I won't be accountable for your safety. The water's coming down and you're right in the beam. Get out of there!"

Ralph ignored the intercom, straining to hear through the steel door.

"Did you get them, Adams?"

He thought he heard a shuffle, but he wasn't sure. Adams would still have time to puncture the tubes, he knew. He couldn't leave yet.

"Look at them, Adams. They're still charged up. Look how fast they're discharging! You've had more than tolerance already. If you stay in there any longer you'll be killed. Look at them, Adams! Look at them!"

The intercom spoke again. It was Sutherland's voice. "Come out of there, Thaling."

Ralph could see, in his mind, the lowering water level that bared the

deadly sodium. The gamma flux would be enormous, filling the air with silent, invisible death, ripping and chewing his cells apart as he stood on the ladder.

"Adams!" he screamed at him. "Look at the pencils! You've only got seconds left! Get out of there! Get out!"

The ladder swayed as he grabbed the edge of the opening, screaming uncontrollably into it, "Get out! Get out!" The frustration and confusion seized his mind as he screamed, stretching seconds into lingering, maddeningly slow hours, the thought of the radiation adding counterpoint to his loud, hoarsening voice. Almost without realizing it he was off balance and falling as the opening door smashed into the ladder and toppled it, his balance gone and his arms flailing as he struck the concrete, the red gouge of pain on his legs and back almost unreal and then he was on his feet and running, running, away from the steel door and into the safety of the corridor beyond.

He stood for a long time after he stopped running, his breath coming in short, painful gasps and his legs weak and almost uncontrollable. He leaned his back against the corridor wall and breathed, his thoughts washed away by pure relief. After a while he heard footsteps coming toward him but he didn't turn.

"Thaling?" A voice said.

He turned slowly. It was a radiation monitor.

"Where've you been? Cease got worried when you didn't show up. They got Adams, by the way. I guess you did a good job on him—he was almost babbling. We checked his pencils—the ones you threw in to him. He's going to be a mighty sick boy."

The monitor paused, waiting for a reply. Ralph just looked at him, breathing through his mouth, not thinking.

"You better come along to Medical," the man said. "They'll want to watch you for a few days. I don't think you've got too much to worry about, but they'll want to watch you." He paused a moment. "Coming?"

Ralph swallowed noisily, then tried breathing through his nose.

"Did they get him?" he said.

"Who?"

"Adams."

"Sure, I told you that. They got him. I said that a minute ago."

"I hope they kill him," Ralph said. "I hope they hang him. I want to be there when they hang him."

"Sure," the man said uncertainly.

"I'd like to kill him with my bare hands," Ralph said.

"Sure," the man said. "Sure. Come on, now. You better get over to Medical."

"All right," Ralph said. "Whatever you say."

They went down the long, concrete corridor together.

THE END

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BY P. SCHUYLER MILLER

"ONE WORLD"

One of the basic tenets of science fiction is that we will eventually have a one-Earth—or one-System, or one-Galaxy—culture encompassing all languages, races and even species. By the same token, now seeming to spill over into "serious" nonfiction, there is the "lost race" or "lost civilization" theme which holds that we have backslid from some such planetary culture which existed in the remote past. This resurgence of a science-fiction theme, in a series of books presented for serious consideration, is worth some discussion.

A generation ago the late Colonel P. H. Fawcett had made himself the personification of the romantic British explorer who believed in wonders beyond the ranges. "Lost Trails, Lost Cities"—Funk & Wagnalls Co., New York. 1953. 332 pp. $5.00—his incompleted memoirs, has been published now, twenty-seven years after his disappearance, by his son, Brian Fawcett. Fawcett's basic belief was that the hinterland of Brazil held the remains of a high civilization, higher than those of Peru and Middle America and presumably of "great" age.

In "America's Ancient Civilizations"—G. P. Putnam's Sons, New York. 1953. 334 pp. $5.00—A. Hyatt Verrill and his wife, Ruth Verrill,

credit the Sumerians with being the founders of the high civilizations, not only of the Americas but of the entire world. Harold T. Wilkins, in his "Mysteries of Ancient South America"—Roy Publishers, New York. 1952. 216 pp. $4.00—cuts across both books with a completely uninhibited "proof" that the Brazilian cities, as well as the pre-Incas and others, were colonies—or perhaps even the motherland—of Atlantis, and date back ten to twenty thousand years.

Finally, in quite a different category, there is Thor Heyerdahl's imposing compendium of parallels between America and Polynesia, the background for his Kon-Tiki expedition, "American Indians in the Pacific" —Rand McNally and Company, New York. 1953. 821 + xv pp. $15.00. The American edition seems to be printed from the Swedish plates and costs less than the English and Canadian editions.

If you come to the Fawcett book, as I did, expecting a long account of the author's more exotic ideas about a lost Brazilian civilization, you will be disappointed. Instead you have an amazing travel book—the experiences of a young artillery officer who came to South America in 1906, to referee the boundary dispute among Peru, Bolivia and Brazil, and who to all intents and purposes never went home. He shows you a picture of human brutality at its worst, in an era when Indians were considered less than animals—when life in the deep jungle went on as it must have done for centuries.

Other reviewers have called "Lost Trails, Lost Cities" one of the great personal adventure narratives of our time. It closes, of course, before 1926, when Colonel Fawcett, his son and a friend vanished into the Matto Grosso in search of "City Z." And very little of Fawcett's ideas about the supposed Brazilian cities appears. Obviously he was saving that until he had evidence to show for his beliefs.

The impression of honesty and sincerity comes through clearly. Of course, there is Fawcett's story of the sixty-two-foot anaconda he killed on the Rio Negro (Raymond Ditmars, the top reptile man, allows only slightly over twenty feet as the maximum—based, however, on zoo specimens). There is his "Double-Nosed Andean Tiger Hound": "the two noses . . . as cleanly divided as though cut with a knife." (I suppose Indians, given such a freak mutation, *might* breed it on the theory that two noses are better than one for scenting jaguars!) And there is his story of the little black statue, a gift of Rider Haggard, which a psychometrist linked with Atlantis. But you will find that Fawcett makes a clear distinction between what he saw himself and what he heard rumored—which is a great deal more than some of the Sunday-supplement reporters who "quoted" him seem to have done.

The story of the Brazilian cities seems to originate with a nameless Portuguese adventurer, who in 1753 went gold-hunting in the Brazilian back-country west of Bahia and the Rio Sao Francisco. Wilkins, by the way, quotes his account in full. The story, written to please the current *politicos* and hence quite possibly pure fiction, was pigeonholed until 1841; it seems still to exist. Both Fawcett and Wilkins cite other attempts —and reputed successes, as recent as 1913—to find the Brazilian cities. And in his last chapters Fawcett hints that he did at last see—something:

"I doubted for a time the existence of the old cities, and then came the sight of remains that proved the truth of at least part of the accounts."

What remains? He never says. That was to be the story he would write after he came out of the Matto Grosso —for the project on which he vanished was to penetrate the region from behind, from the south, reaching the Amazon drainage (where his trail vanished), then driving east through the territory of the mysterious "Serra Roncador" to "City Z," eventually coming out on the Sao Francisco where the chronicler of 1753 had gone in. It was a tough order for a man of fifty-nine, alone with two young greenhorns, but if anyone could have made it in 1926, Fawcett could. He didn't.

But why do I ramble on like this? Surely if there are lost cities and a lost high culture on the Brazilian plateau, similar to those elsewhere in the highlands of ancient America, the archeologists will have described them—and if it's all hogwash and moonshine, the professors will tell you what *is* there.

Only—they don't. They say nothing at all about the region.

There may be accounts, plenty of them, in Brazilian journals: if so, neither Fawcett in 1926 nor Wilkins in 1952 mentions them in support. And the most recent and complete overview of the past and present Indian cultures of all South America, the Bureau of American Ethnology's six-volume "Handbook of South American Indians," treats the Brazilian uplands as if they don't exist!

I don't make of this a scientific conspiracy to conceal what is common knowledge, but "embarrassing" to "orthodox" theories. I do see an admission of out-and-out ignorance of the entire region, past and present. And what better place to lose a lost civilization than in such a hole in the map?

Followers of Fawcett can, indeed, find some crumbs of comfort in the "Handbook." There *is* a zone of high ceramic development in pre-Columbian times at the mouth of the Amazon and along various of its lower tributaries, whose relations to and connections with the other centers of culture are unknown. The nearest place where rumor places high cultures is in the Brazilian highlands where

"City Z" is supposed to be.

Geographically, this region is almost continuous with the highlands in Bolivia and Peru where high cultures did rise. So far from being trackless and impassable is the region between that in the late fifteenth century Guarani Indians from the Matto Grosso raided the eastern Inca frontier—and in 1540 the Tupinamba, *en masse*, left the coast of Brazil in search of a legendary "land of immortality," and showed up nine years later in Peru!

True, repeated flights have been made over the region where the lost Serra Roncador and its cities are supposed to be, during and after the war, and no mountains are there. But both the "Handbook" and Fawcett's accounts show that the area is a dissected tableland—mountains from below, going up, but flat as a pancake from the air. (Conan Doyle, by the way, based "The Lost World" on Fawcett's accounts of these Matto Grosso mesas—not on the Guianas.)

What sanity and calmness there is in Colonel Fawcett's account is certainly lacking in the Wilkins book. "Mysteries of Ancient South America" is a work of the class which puts the revelations of Madame Blavatsky on a par with the chronicles of the Conquistadores and the finds of—usually nineteenth century—diggers.

The world in which the author believes—and it is in some respects the picture Fawcett held, too—is an America in which high cultures existed *before* Atlantis, when a sea filled the Amazon basin and cut up South America into highland islands, each with its own great civilization. On Brazil a "lost" white race built strange cities, lit with globes of never-dying fire, twenty-five thousand years ago. Over in the Andes another civilization centered around an allegedly thirteen thousand-year-old Tiahuanaco, which had been raised from sea level when the Andes were built—orthodoxly this event happened at the end of the Cretaceous, some sixty *million* years ago, but I suspect Mr. Wilkins would maintain quite happily that Tiahuanaco was there at the time.

With the collapse of Atlantis, the rising of the Andes and the Amazon, black-robed missionaries from the old cities set out to educate the shattered peoples of the world and restore civilization.

It is the exasperating and discouraging feature of such books as this, that fact is so inextricably mixed and muddled with rumor, misstatement, conjecture and out-and-out fiction that anything thought-provoking is completely lost in nonsense. Wilkins does reprint a translation of the Portuguese manuscript of 1753, and quotes lavishly from other contemporary—if often unidentified—chroniclers. He offers an eight-page bibliography—it would, of course, take years to check his references. But he attributes statements to Fawcett which the latter certainly didn't put into his own book,

and makes flat statements about inscriptions all over the New World which are allegedly "identical" with those in Asia and Africa. From Madame Blavatsky and her theosophists he gets occult confirmation for a system of colossal, treasure-crammed tunnels underlying the Andes from Ecuador into Chile!

Books such as this completely discredit any possible factual hints to be derived from the explorations of Fawcett and other lost-city-hunters. Since no one seems to have looked, there is no fundamental reason why this part of Brazil could not have held a high, pre-Columbian culture—perhaps, in view of the Guarani and Tupinamba treks, which "orthodox" anthropology accepts as actual, as an outlier of the Andean region. Unknown high cultures have turned up in Panama and Mexico in the last twenty years, and there are certainly more to come. I'd say, "Not proven."

☆ ☆ ☆ ☆ ☆

This discussion will obviously have to be carried over to January, since I'm just getting warmed up. First, though, I have one announcement to pass on which you may not have seen.

I have just received the list of 1953 International Fantasy Award Winners —presentation was to be at a dinner in London, August 25th. The fiction winner is Clifford D. Simak, for "City"; the nonfiction award goes to L. Sprague de Camp and Willy Ley for "Lands Beyond."

Runners-up: in fiction, Cyril Kornbluth's "Takeoff" is second, with Kurt Vonnegut, Jr.'s "Player Piano" third; in nonfiction, the *Collier's* symposium, "Across the Space Frontier" took second place with Martin Gardner's "In the Name of Science" third.

I don't know who could quarrel with these selections. If we were to run another best-book poll now, I suspect all three novels would stand high and might even place. The nonfiction titles, of course, belong in every ASF reader's library.

THE BEST FROM FANTASY AND SCIENCE FICTION: SECOND SERIES, edited by Anthony Boucher & J. Francis McComas. Little, Brown and Company, Boston. 1953. 270 pp. $3.00

Little, Brown have neglected to print the simple words, "Second Series," on the spine of their dust jacket, and with that omission are giving a good many potential buyers the idea that this is the first Boucher-McComas collection, and that they already have it. I've pointed out their error when I could, but after all I can't be in every bookstore in Pittsburgh every time a science-fiction or fantasy fan comes in. Sorry.

These *F&SF* anthologies, then, have become annuals. As is the magazine from which the stories come—some original there, many reprinted

from other sources—the book is heavily loaded with fantasy of the closest present approach to the old *Unknown Worlds* school. Of the eighteen stories in this collection, only half a dozen—say a third—are out-and-out science fiction.

Ralph Robin's "Budding Explorer," which opens the book, tells what happened to Yeevee of Keelee, who came to the United States to investigate election customs and mating protocol. Pure farce and funny. In "The Tooth"—borderline s-f—G. Gordon Dewey tells how an odd object found in the Arizona desert was used to build dreams into reality. Idris Seabright has a mood-piece of after Armageddon in "The Hole in the Moon," and in "Ransom" our own H. B. Fyfe deals with a simple misunderstanding which spoiled the plans of a feudal overlord on an unspecified world.

In "The Hyperspherical Basketball," H. Nearing Jr., gives us one of his scientific comedies of Professor Cleanth Penn Ransom and his long-suffering colleagues. Zenna Henderson, in "Come On, Wagon!", has a disturbing little story of the powers of little children—for my money, the most memorable of this lot. And John Wyndham's "Jizzle" is another grimly mocking little masterpiece about a strange creature and her relations with her master.

Finally, Mildred Clingerman's "Stair Trick" can be considered a neat variant on the dimensional theme, Alfred Bester in "Hobson's Choice" has something to offer to time-traveling, and the tailpiece, Ron Goulart's "Letters To the Editor," is farce again—a satire on some readers' columns in some science-fiction magazines.

I will have to be briefer with the fantasies, except to list them and point to a few highlights. Jan Struther, for example, has a devastating point of view on the Cinderella story in "Ugly Sister." Sprague de Camp and Fletcher Pratt have another in their Gavagan's Bar series, "The Black Ball"—could this be science fiction too? And Manly Wade Wellman, a veteran science fictionist of whom we hear too little nowadays, has one of his fine new mountain fantasies of John the ballad-singer, "The Desrick on Yandro."

To round out the count, Robert Graves writes "The Shout," Australian aboriginal magic in England; Jack Finney, "The Third Level," which some may prefer to call time travel; Elizabeth Bowen, "The Cheery Soul," the ghost of a cook; Margaret Irwin, in "The Earlier Service," a story of the M. R. James school; and Ken Bennett, "The Soothsayer," prognostication by ghost.

In general, the stories are very short by ASF standards. You'll note that several "name" writers—Struther, Graves, Bowen, Irwin—are represented. If you like the *F&SF* flavor,

this is your book—and several of the stories will appeal to anyone.

THE MYSTERY OF OTHER WORLDS REVEALED. Sterling Publishing Company, New York. 1953. 144 pp. $2.95

As the paper-backed Fawcett Book No. 166, published at 75¢, this picture-book is well worth its price. When the same pages are put between boards and the price upped nearly four hundred per cent, that's another story.

The text has been gathered from many diverse sources—*True*, *Harper's*, *Journal of the British Interplanetary Society*, *Mechanix Illustrated* among them. The authors are as varied, and sometimes not fully in agreement. But the pictures, gleaned from rare old books and journals, motion picture stills, astronomical photographs and reconstructions, Edd Cartier's "zoo" from "Travelers of Space"—these, by and large, are handsomely reproduced and well worth the price of a balcony seat at the matinee. You can probably get your copy bound for less than the price of the hard-shell edition.

HELLFLOWER, by George O. Smith. Abelard Press, New York. 1953. 264 pp. $2.75

Our unabashed space-opera, this month, is in the capable hands of the Old Master who can write science-puzzles like "Venus Equilateral" or crime-among-the-stars like this, and do them equally well.

Charles Farradyne, who cracked up a ship on Venus and was degraded to the fungus fields, gets a chance to work his way into the mysterious, untraceable organization which is peddling the ultra-aphrodisiac Hellflowers—gardenialike blossoms whose fragrance is deadly. Within thirty pages he is saddled with a dope-sodden, runaway debutante whom he agrees to deliver to her parents in Denver. En route she kills his contact with the peddlers. Page 80 and he's made new contacts, on Mercury—and has remembered a peculiar little something which is a typical George O. quirk. Page 150 and he's on his way to a rendezvous in space. Then the fun begins . . .

This is exactly the formula of that other Smith's "Lensman" yarns, with the love lotus peddlers standing for Boskone, and with a secret behind them as there is one behind Kinnison's adversaries. But where E. E. Smith tosses suns around and makes you like it, George O. gets his effects with ordinary, very likable people and some straightand logical thinking where it does the most good. It's top-grade space opera—"Carmen" to "Skylark" Smith's Wagner.

(P.S.: Ohio State University has just announced that bluejays have the strange ability which Farradyne discovered in the love lotus peddlers. I've heard hard things said of jays, but never that . . .)

WORLDS OF TOMORROW, edited by August Derleth. Pellegrini & Cudahy, New York. 1953. 351 pp. $3.95

August Derleth's newest anthology of "off trail" science fiction shorts is better reading than his two big collections on the evolution of the genre, but it somehow misses being top level.

This may be because the editor has worked hard to find good stories which have not been used in other anthologies. Ten magazines are represented among the nineteen stories, this one three times. One story, Carl Jacobi's "The Gentleman is an EPWA," has just been announced for the next issue of another magazine, and Donald Wandrei's closer, "Strange Harvest," is not credited to any source and is apparently an original and not a reprint. All the selections, by the way, are quite short.

To me, the top story in the book is Theodore Sturgeon's "The Martian and the Moron," which, as you would know, is a very human little tale indeed, in which father and son use different approaches to the problem of communication with Mars, only to find they are on the same track. Next, perhaps, is Ray Bradbury's ugly little vignette of the near future, "The Smile." Up there with them is Fritz Leiber's "The Enchanted Forest," here in October '50.

Several of the entries are of the novel-twist school which dominated science fiction not too long ago. They are well done of their kind: Edmond Hamilton, who was once *the* symbol of the formulae he had practically invented, completely tricked me with his last-line snapper in "The Dead Planet." Then there is Arthur C. Clarke's "The Fires Within"—intelligent creatures of vastly greater density than ours, living deep in the Earth—Margaret St. Clair's "The Gardener"—an other-planet monster revenges an attack on its charges in true haunted-abbey form—and Frank Belknap Long's "The Great Cold"—in the far future men are the dwarfed slaves of giant, intelligent barnacles. H. P. Lovecraft is represented by a very minor "dimensional" tale, "From Beyond," which seems to satirize his style and themes better than anyone else has done.

Looking the book over this way, the cumulative impression is of a good issue of one of the top magazines of the 1940s, without anything very memorable about it as to novelty or writing but of top workmanship throughout. Poul Anderson, with "The Tinkler," has an unpleasant little story of a boy on a strange planet. Clarke's "Superiority" shows the author's versatility with the doggedly inevitable illustration of a paradox: the enemy who won a galactic war because of his *inferior* science. Derleth's own "McIlvaine's Star" is another secrets-from-beyond tale, and Paul W. Fairman's "Brothers Beyond the Void" is a surprise-ending tale of an

explorer's reception on Mars.

Stuart Friedman and Mack Reynolds are represented with two ironic short-shorts: the former's "Beautiful, Beautiful, Beautiful" in which G17AZ (q):444,801,735-Male runs amok in defiance of his society, and the latter's "The Business, As Usual," which gives that business to an innocent time traveler from our era.

Remaining, we have H. B. Hickey's "Like a Bird, Like a Fish" with a Mexican villager deftly upsetting an invasion of Earth; Jacobi's "EPWA" story—man-versus-robot on steaming Venus; Lewis Padgett's "Line to Tomorrow"—a telephone line, first connected up here in 1945; William Tenn's "Null-P," a neat little satire of inspired mediocrity—*not* the author's; and Wandrei's tale of the Great Invention that turns vegetation obstreperous.

If an anthology can be very good without being outstanding, this is it. "Slick" science fiction, you might call it.

THE DEMOLISHED MAN, by Alfred Bester. Shasta Publishers, Chicago. 1953. 250 pp. $3.00

Here is the best book Shasta has had since "The Man Who Sold the Moon" and one of the top books of recent years. Readers were nominating it for the "Basic SF Library" list a full year before it came out—as they were C. L. Moore's "Judgment Night"

and Leigh Brackett's "Starmen," incidentally.

Mystery—with the killer known—and detection—find the evidence—have not been so successfully combined with a future setting in any book I can recall. We see Ben Reich, tycoon of the year 2301, deliberately plan and execute a brutal murder. We do *not* see, directly in front of our noses, the crucial bit of evidence which we have and the detective, telepath Lincoln Powell, does not and which shows why D'Courtney had to die and who the Man With No Face of Reich's nightmares is.

But detection and pursuit by telepathy—"peeping" by "espers" of graded abilities—are utterly fascinating as Alfred Bester shows them to us, and the culture in and against which the action takes place is as grotesque and repulsive as any we have been shown: in its way like that of the contendingly memorable Pohl-Kornbluth "Space Merchants." Bit by bit, step by step Linc uncovers Reich's trail, comes to physical grips with him under artificial "frontier" conditions on a play-world, gets his physical evidence—and is told by Old Man Mose, the police analogue computer, that he has found no motive. He has one resource left, creepily cruel, and he uses it mercilessly to demolish Ben Reich as completely as he has recreated the shattered personality of the victim's young daughter.

The book is a complete rewriting of the serial version. It will be a classic, and in the midst of some tough competition may well be rated the best s-f novel of 1953.

WITCHES THREE. Twayne Publishers, New York. 1952. 423 pp. $3.95

Since this tripartite giant is fantasy, it wouldn't ordinarily fit into this department which leaves its editor to pick up such things for himself, if they amuse him. They do, and I did, and since the lead-off story was one of the best-remembered gems in our lamented *Unknown Worlds*, here's a report.

That classic is Fritz Leiber's "Conjure Wife," a really book-length novel in which a university professor discovers that his wife is practising witchcraft to protect him from the other witches among the faculty wives. He makes her give up her spells, only to find that he has made them both horribly vulnerable. By reasoning out mathematically the "science" behind the magic of various peoples, Norman Saylor is able to build a stronger magic of his own.

The second story, a novelette by James Blish, offers scientific rationalizations for lycanthropy and witchcraft, and pits a young witch against a werewolf in a spine-tingling running battle through night and snow. Another top-notcher of its kind which would certainly have been in *Unknown* if *Unknown* had still existed in 1950.

The third story, filling nearly half the long book, is Fletcher Pratt's "The Blue Star," which readers seem to like or dislike violently. It is a rambling romantic story of witchcraft and skulduggery on an "alternative" world which strongly resembles that of the author's "Well of the Unicorn" —Sloane, 1948, written as "George U. Fletcher". This is told in an odd sort of prose which seems to be compounded of James Branch Cabell, Robert E. Howard, and—logically enough—the author's own "Incomplete Enchanter" collaborations with Sprague de Camp. The result irks some people: I like it.

If you like fantasy at all, this is certainly a must for you. And what with Leiber's symbolic logic, Blish's glandular theory of werewolves, and Pratt's parallel world in which magic is the norm, you can make a pretty good case for calling this science fiction as well. Because, by my tenets, anything that exists must have a scientific explanation—and a host of witnesses claim that witches and werewolves do exist. Me, I've never met one—to my knowledge. But I've never been on a college faculty . . .

BRASS TACKS

Dear John:

May a phonetician—authentic if amateur—put an oar into the argument about spelling-reform that seems to be blowing up amongst Messrs. Edwards, Ruyle, and Benson, not to mention yourself? If we can eliminate some unnecessary errors of detail it may turn out that there is nothing much to fight about after all.

First, Mr. Ruyle says "ai laik owr speliq as it is." He has a perfect right to like English orthography if he wishes; one can only say that his taste is a little peculiar, as if a man said he liked having a toothache.

Second, Mr. Benson is not quite right in his judgment of the orthography of Continental European languages. French is virtually as unphonetic as English; thus *ci*, *scie*, and *si* are all pronounced alike; so are *cent*, *sang*, and *sans;* so are *mer*, *mère*, and *maire*. Portuguese, Swedish, and Polish are also quite irregular; so is Modern Greek, largely as a result of trying to fit the spelling of Homer and Herodotos to what has become a quite different language. Spanish, Italian, and German are better but still a good way from perfect. Thus in German *Kuss* and *Fuss* do not rhyme, though you would think so to look at them. Even Czech, which has one of the most regular orthographies in the world, is not quite phonetic: it uses *i* and *y*

to symbolize the same sound. Danish is so irregular that the proper pronunciation of the name of the capital of that country has been a matter of political controversy.

The reform in Russian spelling was not a major one, consisting largely of the dropping of a few redundant letters, since this language is almost unique in having more than enough letters to represent its phonemes. The Dutch did reform their spelling some decades ago. The Swedes talked about doing so but never quite got around to it. The French are now considering a drastic reformation of their spelling proposed by a governmental commission, but knowing what usually happens to such things I shall be pleasantly surprised if anything comes of it beyond talk.

The real trouble, which none of our friends has mentioned, is that most people are extremely selfish and oppose being put to any trouble or expense for some theoretical or long-term benefit, such as the good of mankind or of posterity. Therefore, it usually takes either a revolution or a dictator like Mustafa Kemal Atatürk to force any drastic change in habits, no matter how irrational, to which people as a whole have become accustomed. Thomas Jefferson tried to effect the adoption of decimal coinage and weights and measures; he was successful with the first only, though the virtues of the metric system of weights and measures were debated for years in the

early Congresses. And though the Irish have been damning everything British for centuries, when they got their independence they retained the three most irrational and inconvenient features of Ango-Saxon culture: the spelling, the coinage, and the weights and measures.

As for your arguments, John, shame on you. To teach children that human generalizations are unreliable by forcing English spelling upon them is like teaching them that life is full of pains and disappointments by stringing them up by the thumbs every day and flogging them. And English is so widespread for two reasons having nothing to do with its spelling. The first is that during the last few centuries English-speaking people have written a great deal of stuff worth reading. The other is that during this same time English-speaking people, in their numerous arguments with Frenchmen, Spaniards, Dutchmen, Asiatics, Africans, and Amerinds, have shot faster and straighter.

Sou, hwail mai haart iz wi8 Mister Benson in hiz kruseid, ai xal kiip mai fiñgerz krost and biliiv in it hwen ai sii it. Meibi if anœ+er woor blouz nainten8s ov œs of +e map, +e servaivers wil hav a txans tu put +iiz rifoormz intu ifekt. — L. Sprague de Camp, Wallingford, Pennsylvania.

Hey, Sprague—when a scientist finds a consistent pattern in phenomena, he looks to see if there is a cause. Why *have English-speaking people written stuff worth reading? Why did Joseph Conrad pick English? Why did English-speaking people so consistently shoot straighter? I'll be darned if I know, but there must be some reason!*

Dear Mr. Campbell:

For the AnLab:

April, 1953

Ratings by Leedham's ten-point system:

1. Mission of Gravity, by Hal Clement	10
2. The Ant and the Eye, by Chad Oliver	9
3. Settle to One, by Dye and Smith	8
4. Allegory, by William T. Powers	7
5. Family Resemblance, by Alan Nourse	7
6. Nature Didn't Make It!.	8

An excellent issue. I think that Hal Clement has fairly earned the bonus for this month.

The article suggests a need for a new word to express the "unstickum" qualities of certain silicones. I offer "dehere," "dehesive," "dehesion," et cetera; derived, of course, from "adhere" by analogy to "accelerate" and "decelerate."—PFC George W. Price

So we could say "A fool and his money show high dehesion."

Dear Mr. Campbell:

Dalton Edwards' spelling reform article seems to have evoked a constant stream of letters for "Brass Tacks" from both sides of the fence. It seems to me that these letters overlook what could be a major difficulty. Any reformed spelling would almost certainly be phonetic in nature and therefore regional variations in pronunciation would show up in spelling. This could be quite serious: consider the case of a Southern author, a mid-western typesetter, and a Vermont reader—or any other such combination. An idea of the confusion that could be created can be gotten by reading either an Olde English manuscript or a book written in some unfamiliar dialogue. Undoubtedly a "national American speech" would evolve but think of the confusion until then. Several S-F authors have pointed out another pitfall of phonetic spelling, the temptation to move your lips while reading is very strong. Moving your lips, of course, cuts down drastically on reading speed. It is possible, however, that this second difficulty could be overcome with practice.—Richard M. Rickert, 1291 Putnam Avenue, Brooklyn 21, New York.

The movies and radio succeed in national communication with a single dialect!

Dear Mr. Campbell:

My compliments to Poul Anderson for the swell job he did of building a fine story around the old ballad in "Sam Hall" (August, 1953). I think the song is usually sung with the refrain "blast your eyes" instead of "damn your hide," but it is still one of the most unrepentant bad man ballads we have.

If any other of your faithful readers are interested in folk music, they may be interested to know that two Ameri-

can folk singers have recorded "Sam Hall": Bill Bender in "Frontier Ballads," Asch album 410, and Carl Sandburg in "An American Songbag," Musicraft album M-11, according to information supplied me by the Canadian Broadcasting Corporation.—Allan Bernfeld, 5235 Cote St. Luc Road, Apartment 45, Montreal 28, Quebec.

The "Sam Hall" versions vary through the midwest, pretty much from state to state. The version given was a Michigan-Wisconsin version.

Dear Mr. Campbell:

No one was more astounded than the girl next door to learn, from the otherwise wide-ranging article of Wallace West (June Factual) that she had been working all this time for the United States Weather Bureau, coding for the Los Alamos MANIAC Computer. Do you suppose this is why Congress is investigating the effect of our Las Vegas tests on the weather?—D. W. Serf, 1027 9th, Apt. 19, Los Alamos, New Mexico.

Since Astounding is, of course, infallible, this must be the explanation. But is the Weather Bureau a subdepartment of the AEC or is it the other way round?

Dear John:

First, the bouquet: Since I have read every issue of ASF, from Volume I, Number 1, to include September, 1953, I feel qualified to say that, to me, this magazine has consistently the highest cross section of useful, entertaining, stimulating points of view of all the publications which I have been able and willing to read. Since economics is my chosen field, I consider myself no judge of literature, and have, therefore, felt no urge to project my personal opinions into your Anlab; however I have read many of these stories and articles as many as ten times, and keep a file of back issues to loan to my less fortunate friends. ASF, during all these years, has kept me ahead of the crowd, first in the rapid unfolding of the physical sciences, and recently has made me aware of the expotential rise of reason in the social sciences. ASF has practically compelled me to spend thousands of hours of my free time in the study of such closely related subjects as nuclear physics, colloid chemistry, astronomy, mathematics, logic and philosophy, psychology, neurology, cybernetics and semantics. I am one of the many who approached Dianetics with open-minded skepticism, developed an active enthusiasm, got solid, lasting benefit from the method, and finally got off reluctantly when Hubbard changed trains. In short, ASF has widened my horizons while simultaneously affording me excellent entertainment, and for this I am sincerely grateful.

What finally stimulated me to

write, however, was two letters in September, 1953, Brass Tacks—one by G. J. Williamson of Philadelphia, taking you brutally to task for mentioning the foul name of Aristotle in the public prints, and the other by Robert Wolff of Harvard, giving you faint praise for a partial and tentative reacceptance of two-value logic, but making it quite plain that anything less than a total and exclusive acceptance of Aristotle is paltry stuff. You invited them to continue the discussion, and the prospect of an Aristotelian non-Aristotelian and a non-Aristotelian Aristotelian belaboring each other on the subject of logic fascinates me.

Both are, no doubt, learned and earnest gentlemen, and I salute their eloquence and missionary zeal; however, Mr. Williamson seems unaware that his emotional rejection of Aristotle implies an "either-or" assumption, and demonstrates that his Thalamus is still tightly bound to two-value logic; Mr. Wolff, on the other hand, seems willing to accept any development of art and science as long as we remain properly reverent toward the Fountainhead of all Wisdom.

Mr. Williamson says, "Your editorial in the April issue of ASF *is* one of the worst I have ever read." (Identification?) "I have never before seen an editor who was so *arrogant* (Snarl noise?) as to *antagonize his readers* (Projection?) with articles such as you have been writing." Altogether, in Mr. Williamson's letter, I count the following violations (to me) of multivalued principles: Projection—28, Appeals to authority—6, "Either-or"—10, Allness—10, Word magic & noises—20, Class thinking—11, Judgment presented as description—13, Failure to date—7.

It seems to me that many advocates of general semantics have merely abstracted from Korzybski a new set of

"truths," and have gone blithely on, using Aristotelian methods in their speech and actions, but with their major premises taken from "Science and Sanity." Adoption of the label "non-Aristotelian" in itself implies "either-or." My abstraction of Korzybski's writings includes the concept that I should examine, one by one, each of *my* habitual methods of thinking and each of *my* signal reactions, so as to develop the habit of avoiding those reasoning devices which seem to be non-useful. Admittedly, this is much more difficult than seeing these faults in others, and admittedly I have made small progress in that direction, as this letter no doubt shows, but the effort seems to me to be worth while.

To preserve my pretensions of neutrality, let me say that Mr. Wolff defends Aristotle very ably on the flank, and leaves Korzybski's frontal attack unopposed. Granted, Aristotle's principle is properly stated: "A is either black or not black" and granted that "not black" may be enlarged to encompass the remainder of the universe, so that the Aristotelian need not confine himself to the consideration of paired opposite qualities. To me, one of Korzybski's most useful statements was: "Whatever we say a thing *is*—it is not." A cogent way of saying that regarding the physical universe, we cannot say *all* about anything, we cannot say anything *for sure*, and we cannot say anything *for all time*. This concept, if we accept it, orphans us from the soft bosom of "Truth," and forces us out into the cold world of probability and approximation. The comforting thing about "Truth" is that, if we know a thing is true, *we do not need to put it to the test of observation*. Aristotle, for example, stated "un-equivocally" that ants have eight legs. He felt no need to pick up an ant and count its legs, because it was "true" that there were eight. How often do we, "Aristotelian" and "non-Aristotelian" alike, fall into this same easy habit?

In my opinion, Korzybski's major attack was not against the method of syllogistic reasoning as such, but directly against the major premise itself. In a valid syllogism, the major premise must contain a general term, i.e. a statement that *all* or *none* of a particular class possess a particular quality. The major premise must be "true" in order for the syllogism to be "true," and Korzybski asserts the impossibility of stating a truth about the physical world. By saying, "A is black" he would recommend that we imply, "I choose, for convenience, to consider A as a member of the class which I call black." Once this assumption becomes habitual, the user of multi-valued logic is free to employ the syllogism as a convenient and useful classification device.

Let me, then, examine some of the major premises in Mr. Wolff's letter: (1) "Since most of your stories are chemically, physically and biologically

correct—" To paraphrase Mr. Wolff, "ninety-nine per cent" of the errors committed by philosophers in their thinking about science lie in the use of the phrase "exact science." My limited reading indicates that scientific writings run heavily to phrases like, "Observations so far made indicate that—" "The margin of error in these measurements is estimated as—" "It seems—" "Further investigation along these lines seems indicated," et cetera. I have known several practicing scientists, and none of them were willing to guarantee that their statements were "correct"—they only maintained that they were currently operational. A scientist cannot afford the luxury of "truth," because if he does not test his theories, someone else will!

(2) "Every condition ever described in any magazine can be characterized by, and only by, two-value logic." Am I safe in assuming then that Mr. Wolff has examined every magazine that was ever written, or does he say this because he knows it's "true"? (3) "A bucket of water is either hot, or not hot." How hot, for how long, in whose opinion, and under what circumstances? (4) "For every possible state of mind, a person either feels it or not feels it." I'm glad things are so easy for him—sometimes "I don't know how I feel." (5) "Once a sentence has been composed, it is absolutely true that it is either true or false." Supply me, please, with an example—one sentence about the physical world that is "True," i.e. complete, certain and eternal.

Mind, I do not deny categorically that such a sentence is possible—I only say, furnish me *one* such sentence and I will recant my heresy and re-embrace the true faith. (6) "Our actions and feelings are equally shaded, and equally characterizable, completely within old-fashioned Aristotelian logic.

As to why that *fact* is so—" My dictionary defines "fac" as the *past* participle of the verb "facio," i.e. something that *has happened.* Obviously, I am rather fond of my opinions too, but I try to avoid labeling them as "facts."

Let me say, in conclusion, "Et cetera," "Aug '53," and "too me."—Howard W. Martin, Castleton, Indiana.

"Is this a private fight or can anyone get in?"

Dear Mr. Campbell:

Author Ashby—"Commencement Night"—has made a common error. It will probably go unnoticed by most of your readers, but to meteoriticists like myself it sticks out like a sore thumb. He thinks a meteorite is hot when it hits the earth. They are plenty hot during the incandescent part of their fall but that is strictly a surface condition, and while still ten miles or probably much more above the surface, they have decelerated to the point where they no longer glow. The rest of the way down they have a chance to cool off, and by the time they reach the surface, they are barely warm and sometimes they are cold. One that fell at Colby, Wisconsin, is reliably reported to have gathered frost. One in India did the same thing. The stone of Homestead, Iowa, was not warm enough to melt snow. In Forest City, Iowa, one fell on a straw stack but did not start a fire. Allegan, Michigan, carried green leaves into the ground. They were bruised but not cooked. The hottest one for which we have reliable reports was probably the Cabin Creek iron which, during the three hours before it was dug out, partly dried the clay in which it was embedded for a short distance from the surface. This one is very atypical.

It is easy to see why a meteorite should be cold inside, because a black body at the Earth's distance from the sun would have a temperature of about 4° C according to one formula. A. T. Jones calculated that a black body, with the thermal conductivity of iron, at the Earth's distance from the sun, would have a temperature of −4° C on the sunward side and −5°C on the dark side. That the surface becomes incandescent is not important because as fast as material is fused it is swept off. The effects of heating an iron meteorite to 850° C or above for even a few seconds is easily detectable but, if present at all, this alteration zone is seldom more than a few millimeters thick. The thermal conductivity of stone meteorites is much less. The thickness of the fused crust is hardly ever as much as 0.5 mm.

I know it isn't important but I thought you, and he, might like to know.—John Buddhue, 1210 N. Arroyo Blvd., Pasadena 3, California.

If a meteor is that cold, why is the Earth so warm, I wonder?

Continued from page 7

The true scientist is an humble man in another respect; he acknowledges that the Laws of the Universe apply in full to himself; that they limit him as well as others, and will equally help him as well as any other.

He is also a courageous man; he is willing to submit his tender and beloved beliefs to the harsh test of practice and experiment, well knowing that most of the time the experiment will prove him wrong and force him to rebuild, laboriously, the structure of belief he so recently completed.

To the nonscientist he seems very strange. The scientist looks at the Ptolmaic theory of the Universe, and the modern concept of the Cosmos, and says: "They are not very different; each yields the same predicted observations to the first decimal point." His understanding completely confuses the nonscientist, for the scientist holds that facts are very deceptive, yet also holds that all understanding must be based on fact. How can this be?

It's very confusing to the nonscientist to have an electrical engineer and a mechanical engineer get together and say that an automobile transmission gear shift is essentially the same thing as a multi-tapped transformer.

The resultant attitude the scientist shows toward his theories—the way he abandons one and shifts over to "an entirely different" one—makes him seem somehow intellectually dishonest, untrustworthy and unreliable to the nonscientist who cannot see the fundamental similarity of the theories. How can a man honestly say that an automobile gear shift is the same thing as a multi-tapped transformer? Only by recognizing that each is an impedance matching device, that each is a modification and application of the basic principle of the lever.

The scientist seeks the Basic Laws, and is not afraid to find that they apply to him—for he knows that they always *have* applied to him, and always will, whether he acknowledges them or not. The Law of Action and Reaction applied to Ug, the Caveman; it was Ug's ignorance of them that got him into trouble, for the Law applied whether he knew or not, whether he

so willed or not. A Man-made law can seek to limit a human's freedom; the nonscientist many times confuses Man-made law and its effects with Man-discovered law and the results of that discovery. It was not Newton's discovery of the Law of Gravity that kept men from flying—it was the *existence* of the Law that did that. But it was Newton's discovery of the Law, plus the Wright's application of certain laws of aerodynamics, that finally led to Man's flight.

When Ug, the Caveman, caught a small boulder thrown at him, and staggered backward under the impact, he attributed the effect to the *stone*. This was a misattribution of effect; the effect was assigned to the wrong cause. The *stone*, which he could see and which had palpable existence, was obvious; the *momentum* never existed apart from the stone, and was not obvious—until Newton recognized it.

The scientist seeks to achieve a correct attribution of cause and effect; in doing so he invents nothing, generates no new laws, imposes no new limits on humanity. Knowing this, he is not averse to accepting that he is, was, and always will be ruled by the Laws of the Universe.

Characteristically, many human beings lack the willingness to accept that they obey laws they do not know exist. In the field of personality and human relations, for instance, there is a deep rebellion against the idea that there are laws which apply. In that area, then, there are very few true scientists in the sense of individuals willing to acknowledge freely that they are bound by and controlled by Universal Laws they do not know exist.

But one of the most difficult tasks any physical scientist can try is that of defining in what way his basic philosophy differs from that of the sincere, self-searching moral philosopher, with his deep belief in God as the Supreme Authority, and the Giver of Universal Law. Perhaps it is, essentially, that the physical scientist says, in effect, "I have proven beyond doubt that there is Universal Law; I am not yet wise enough to know the nature of its source," while the moral philosopher insists that he knows the Source.

It might help the integration of the physical, social and moral philosophical sciences, however, if each group could state in clearly communicable terms the essence of their beliefs. And this in turn would, surely, help in the integration of our vastly increasing physical competence with our laggard social engineering competence.

THE EDITOR.

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